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Aplikace metodologie CorporateMetrics ve společnosti Air China

Application of the CorporateMetrics Methodology in the Air China Company

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Description:

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2. Description of CorporateMetrics Methodology
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References:

BENNINGA, Simon. *Financial Modeling.* 4th ed. New York: The MIT Press, 2014. 1144 p. ISBN 978-0262027281.
RISKMETRICS GROUP. *CorporateMetrics Technical Document* [online]. Riskmetric Group [1999]. Available on http://www.riskmetrics.com
WINSTON, Wayne. *Microsoft Excel 2013 Data Analysis and Business Modeling.* 1st ed. New York: Microsoft Press, 2014. 888 p. ISBN 978-0735669130.

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The declaration

"Herewith I declare that I elaborated the entire thesis, including all annexes, independently."

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1. Introduction

Nowadays, the whole world runs more frequent and also countries have tighter relations due to the rapid development of transportation industry. From our point of view, airline companies play an important role especially in the case that transportations or communications between a country and the other one. Hence, Air China Company, which is one of the biggest airline companies, is chosen as our research object in this diploma thesis.

The main objective of this paper is going to apply CorporateMetrics methodology for predicting earning after tax of Air China Company in 2014 and 2015 and also estimating the net earnings at different level of risks, which are based on this corporate's historical income statements.

Overall, we split this thesis into 5 main parts.

In chapter 2, the basic methodology of CorporateMetrics will be described. Then, the way to decide the input data and make a predicted estimation will be introduced. Moreover, some important financial models and quantification of risk methodologies will be continually explained in more details. The main purpose of this methodology part is to introduce some basic knowledge of this thesis.

In chapter 3, we will introduce you some basic information about our selected company-Air China Company. This chapter will be divided into 4 sub-parts, which are the overview of this company, description of this company's history, SWOT analysis of Air China Company and airline industry analysis in China.

Chapter 4 is an application part, which is also regarded as the most important part in the whole thesis. In this chapter, the real data and methodologies that are introduced in chapter 2 will be combined together to get the specific value of our selected company. The data will be selected from Air China Company's annual reports.

In chapter 5, after having an overall view of all figures and tables we've got in part 4, the conclusion about this company's past data and predicted estimations will be stated as a final summary.

2. Description of CorporateMetrics Methodology

The objective of this part is to describe the main principles of risk measurement methodologies via CorporateMetrics, methods for determining the input parameters, financial modeling and method of VaR (Value at Risk).

2.1 Overview of CorporateMetrics

CorporateMetrics is a conceptual framework for estimating market risk in the corporate environment. Broadly speaking, CorporateMetrics focuses on two corporate financial results – earnings and cash flow to measure a company's value. Specifically, CorporateMetrics enables companies to predict earnings and cash flows via making a prediction about a range of different market rates, such as foreign exchange rates, interest rates, equity prices or commodity prices.

The Methodology of CorporateMetrics is designed to accommodate long-horizon forecasting to coincide with the long-term management cycle that is typical to corporate planning and business management. Furthermore, CorporateMetrics offers a VaR-type of methodology, the principles of which have been widely used in portfolio risk analysis. Since VaR is regarded as the measurement of uncertainty, or volatility of observed value, it can be easily applied to corporate risk measurement.

2.1.1 Main Features of CorporateMetrics

The framework of CorporateMetrics summarizes the following four components that is considered as key features to this methodology:

- Definition of risk measurement: Earnings-at-Risk (EaR), Earnings-per-share- at-Risk (EPSaR) and Cash-Flow-at-Risk (CFaR).
- Methodological guidelines-explain how to identify and map market-sensitive exposures, and describe the methods available for calculating market risk.
- Data sets and methodologies for long-horizon forecasting (2 to 24 months). The data and methodologies are described in companion publication, the *Long Run Technical Document*[1] (*Long Run*).

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[1] KIM, J., MALZ, A.M., MINA, J.. LongRun Technical Document [online]. 1st. Ed. New York: RiskMetrics Group, 1999 [cit. 2009-01-31]. Available from WWW: <http://www.riskmetrics.com>

- Historical data, stress scenarios, long-term forecasts and methodological discussion, which are available on the website: http://www.riskmetrics.com.

2.1.2 Relationship between CoporateMetrics and RiskMetrics

Considering the similarity, both CorporateMetrics and RiskMetrics have the same target, which is to measure the potential impact of market rate changes on financial changes. In the case of RiskMetrics, it focuses on potential changes in the market values of portfolios of financial instruments over time horizons of one day and one month. However, the CorporateMetrics pays much more attention to the potential impact of market rate changes on a company's financial results relative to the results targeted for a particular period, for example the uncertainty in meeting next quarter's targeted earning after taxes. Also, the time horizons over which financial results can be affected tend to be longer, ranging from 2 to 24 months.

Moreover, there are other parameters, which can see an apparently difference between RiskMetrics and CorporateMetrics. Here we can get the detailed information in table 2.1 as follows,

Table 2.1 Risk management parameters in financial and corporate environments

Parameter	Financial	Corporate
Framework	RiskMetrics	CorporateMetrics
Measure of value	Portfolio value	Earnings, cash flow
Accounting treatment	Fair value (market to market)	Accrual, fair value (market to market), hedge accounting
Horizon	Daily, monthly	Monthly, quarterly, annual
Benchmark	Market index	Specified targets (e.g., budgeted plan, spot, forward, expected and analyst forecast)

2.1.3 Function of CorporateMetrics

Generally, we have 5 main steps to measure the market risk:

1. **Metric specification;**
2. **Mapping risks of the company;**
3. **Scenario generation;**

4. **Assessment;**
5. **Risk calculation.**

In more details, first, we must specify the financial result for which risk will be measured: earnings or cash flow. And also, we need to make sure the time horizons and confidence level for risk measurement. Then using the metric specified above, identify all earnings or cash flow components, as appropriate, whose values can change as market rates fluctuate. Relate the exposures to market rates by defining how the value of each exposure is affected by each market rate. The next step is to generate scenarios, which means generate a large number of scenarios that chart the different possible values for a given set of market rates over time, thus we can see the different paths that make rates can take over the specified horizon. Then, we need to calculate the future financial results, which depends on each value of scenarios. Finally, we can estimate the risk statistics from the distribution of financial results.

2.2 Input Data Estimation

In this part, we will choose two suitable methods, which can predict parameters exchanges rates and jet fuel costs.

2.2.1 Change Estimation

Here we set price as an example to explain the three different types of change estimation. The change estimation is an expression that has good predictive abilities and statistical properties. The input data are the result of observations during a particular period (time series). Once the observation leads to price changes, which are also the subject to measure risks.

The price changes can be expressed in three different ways:

- Absolute change, which is the difference between two prices at different times,

  $$D_t = P_t - P_{t-1}, \tag{2.1}$$

  where P_t is the price at time t, P_{t-1} the price at time $t-1$.
- Relative change, representing the absolute change between time t and $t-1$ divided by price at time $t-1$,

$$percentage\ D_t = \frac{P_t - P_{t-1}}{P_{t-1}}, \tag{2.2}$$

- Logarithmic price change, which is also known as continuous yield, based on the assumption that the total gross price level is equal to the expression (1 + *Rt*),

$$r_t = \ln(1 + R_t) = \ln(\frac{P_t}{P_{t-1}}) = p_t - p_{t-1}, \tag{2.3}$$

where p_t represents ln P_t, and p_t equals to ln P_{t-1}.

The most frequent tools used are relative change and logarithmic change, because they don't consider the price level, but in terms of their sessions.

2.2.2 Probability Distribution

Any price change may have a different probability distribution. When modeling market prices, we have three mostly used types of probability distributions.

Normal Probability Distribution

The normal probability distribution is among the most important probability distribution of a continuous random variable. Normal distribution $N\ (\mu, \sigma^2)$ is based on two values and the mean μ and variance σ^2. While the mean value characterizes the position distribution, the variance of the random variable describes the distribution around the mean value x_t.

The random variable has a normal probability distribution with parameters μ and σ^2,

$$f(x) = \frac{1}{\sigma\sqrt{2 \cdot \pi}} e^{-(\frac{(x-\mu)^2}{2\sigma^2})}. \tag{2.4}$$

Random variables with normal distribution has a mean value,

$$E(X) = \mu, \tag{2.5}$$

And scattering can be expressed as,

$$D(X) = \sigma^2. \tag{2.6}$$

Standard - normal probability distribution

Standard normal distribution is a special kind of normal distribution, indicating as *N (0,1)*. From this indication shows that the mean value $\mu = 0$ and variance $\sigma^2 = 1$.

The probability density of a random variable with a standard normal distribution has a shape,

$$\varphi(x) = \frac{1}{\sqrt{2 \cdot \pi}} e^{(-\frac{(x)^2}{2})}, \tag{2.7}$$

Distribution function for a standard - normal probability distribution can be expressed as,

$$\Phi(x) = \int_{-\infty}^{x} (t) \cdot dt = \int_{-\infty}^{x} \frac{1}{\sqrt{2\pi}} e^{(-\frac{(t)^2}{2} \cdot dt)}, \tag{2.8}$$

where dt represents the time increment.

Logarithmic - normal probability distribution

The random variable has a distribution logarithmic – normal parameters μ and σ^2, expressed as $LN\ (\mu, \sigma^2)$,

$$f(x) = \frac{1}{\sqrt{2\pi}\sigma} \cdot \frac{1}{x} e^{-\frac{1}{2}(\frac{lnx-\mu}{\sigma})^2}. \tag{2.9}$$

Using continuous change that has a normal probability distribution, there is a logarithmic - normal probability distribution P_t prices. The previous relationship is extended and has the following form,

$$f(P_t) = \frac{1}{P_{t-1} \cdot \sqrt{2\pi} \cdot \sigma} e^{-(\frac{(P_{t-1}-\mu)^2}{2\sigma^2})}, \tag{2.10}$$

where P_{t-1} must be greater than zero. Parameters logarithmic - normal probability distribution are defined as follows:

$$E(P_t) = e^{(\mu + \frac{\sigma_t^2}{2})}, \tag{2.11}$$

$$\sigma^2(P_t) = \left[e^{(2 \cdot \mu)} \cdot e^{(2 \cdot \sigma_t^2)} \cdot e^{(\sigma_t^2)}\right]. \tag{2.12}$$

2.3 Financial Modeling

Market prices and yields are characterized by random evolution in time. Such a course is known as a stochastic process that can be described as discreetly with applications in simulations or continuously when using analytical solutions.

For financial modeling is most commonly used Markov random process. Within the Markov process is most often used Wiener process, which is known as a specific Wiener process and is an essential component of other stochastic processes. Wiener process followed by a Markov process, which means that the predicted prices are affected only the current price and not historical prices and changes in market prices are time-independent.

Wiener process can be defined as the following formulas:

$$\widetilde{z_t} - z_0 = d\tilde{z} = \tilde{z} \cdot \sqrt{dt}, \tag{2.13}$$

where $\tilde{z}$ is a random variable of the normal distribution $N\ (0,1)$. For the mean, variance and standard deviation applies,

$$E(dz) = 0, \tag{2.14}$$

$$var(dz) = t, \tag{2.15}$$

$$\sigma(dz) = \sqrt{t}. \tag{2.16}$$

If the development of prices in time for several intervals, then the formula (2.13) can be modified as follows,

$$\widetilde{z_t} - z_0 = \sum_{t=1}^{n} \widetilde{z_i} \cdot \sqrt{dt}, \tag{2.17}$$

This relationship can be expressed by mean value, variance and standard deviation,

$$E(\tilde{z}_T) = 0, \tag{2.18}$$

$$var(\tilde{z}_T) = n \cdot dt = T, \tag{2.19}$$

$$\sigma(\tilde{z}_T) = \sqrt{T}. \tag{2.20}$$

In the following two subsections, we will describe the random walk model and Mean -Reversion model, which are used for modeling market prices.

2.3.1 Random Walk Model

Random walk is a theory[2] in which future actions cannot be predicted based on past results.

Changes in risk factors, there is a risk of adverse developments. These factors should be analyzed and based on the findings and determine their distribution changes over periods. It is therefore expected that revenues in the short term, according to behavior of Random walks.

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[2] BURTON G., M.; A Random Walk Down Wall Street, II. Title. London: W.W.Norton and Company, 1999. 461 p. ISBN 0-393-04781-4

Geometric Brownian process with logarithmic prices

This model belongs to the stochastic processes and the most used type of model in financial modeling. The model can be used to simulate the random evolution of stock prices, exchange rates, commodity prices, etc. for use within CorporateMetrics methodology is used primarily logarithmic price changes, so-called. Continuous yield, which is used, predicted exchange-rate developments. A prerequisite is the development of the course according to equation (2.10). In this case, it is a geometric Brownian process with logarithmic prices defined as,

$$dlnP = \hat{\alpha} \cdot dt + \sigma \cdot d\tilde{z}, \tag{2.21}$$

where trend coefficient $\hat{\alpha}$, standard deviation σ and $d\tilde{z}$ are the random components that are equal to the product of random variables from the standard normal probability distribution $\tilde{z}$ and $\sqrt{dt}$.

Deterministic coefficient represents the average yield resulting from the price increase. This estimate is carried out by least squares method based on minimizing the sum of squared deviations,

$$\sum_{t=1}^{T} \varepsilon_t^2 \rightarrow min, \tag{2.22}$$

where ε_t the residual variation, which indicates the difference between the actual and the estimated yield,

$$\varepsilon_t^2 = \sum_{t=1}^{T} (r_t - \hat{\alpha} \cdot P_t)^2. \tag{2.23}$$

Another coefficient model is the standard deviation, which is calculated as follows,

$$\sigma = \frac{\hat{\sigma}}{dt}, \tag{2.24}$$

where $\hat{\sigma}$ is the annualized standard deviation of a relationship,

$$\hat{\sigma} = \sqrt{\frac{1}{N} \cdot \sum_{t=1}^{T} (r_t - \hat{\alpha} \cdot P_t)^2} = \frac{1}{N} \cdot \sum_{t=1}^{T} \varepsilon_t^2. \tag{2.25}$$

To estimate the need to establish a simulation market prices, the mean and variance. Within geometric Brownian model with logarithmic prices are used following relations,

$$P_t = P_{t-1} \cdot e^{(\hat{\alpha} \cdot dt + \sigma \cdot d\tilde{z})}, \tag{2.26}$$

$$E(P_t) = P_{t-1} \cdot e^{(\hat{\alpha} \cdot dt \cdot n)}, \tag{2.27}$$

$$var(P_t) = P_0^2 \cdot e^{(2 \cdot \hat{\alpha} \cdot T)} \cdot (e^{(\sigma^2 \cdot dt \cdot n)} - 1). \tag{2.28}$$

Generally, the Geometric Brownian Motion can formulate the exchange rates evolution. Here we proceed according to the equation (2.4) for the exchange rates evolution.

Random evolution of the exchange rates:

$$S_t = S_{t-1} \cdot \exp\left(\alpha \cdot \Delta t + \sigma \cdot \tilde{z} \cdot \sqrt{\Delta t}\right). \tag{2.29}$$

Here $d\tilde{z}$ is a random component, with $d\tilde{z} = \tilde{z} \cdot \sqrt{\Delta t}$, and $\tilde{z}$ is a random value from the standard normal distribution N (0; 1).

2.3.2 Mean-Reversion Model

It is for a number of selected variables appearing in the long-term tendency to return to a long-term equilibrium value. Such stochastic processes are referred to as Mean - reversion processes that tend to return in time for a long-term equilibrium or remain in the vicinity of long-term equilibrium. The basis of mean - reversion model is the assumption that the process r_t is governed by,

$$dr_t = a \cdot (r_t, t) \cdot dt + b \cdot (r_t, t) \cdot d\tilde{z}, \tag{2.30}$$

where $a \cdot (r_t, t)$ is the coefficient Wiener process, which also represents a velocity parameter approaching the long-term equilibrium. The second part of the relationship is through long-term balance.

Vašíček Model

Vašíček model is the discrete estimation version of the mean-reversion model. A drawback of the model is that it can achieve a negative value, which is not realistic in practice.

Vašíček model return to center based on the following equation:

$$dP = a \cdot (b - r_t) \cdot dt + \sigma \cdot d\tilde{z}, \tag{2.31}$$

where a, b are estimated parameters, σ is standard deviation, and $d\tilde{z}$ is a random component, which is equal to the product of random variables from the standard normal probability distribution $\tilde{z}$ and $\sqrt{dt}$.

Parameter Estimation

The parameters a and b can be obtained from the linear shape reverse model,

$$dP = \hat{\alpha} + \hat{\beta} \cdot P + \sigma \cdot d\tilde{z}, \tag{2.32}$$

with the help of which provides linear parameters, which can be re-expressed initial parameters of mean-reversion model.

The parameters $\hat{\alpha}$ and $\hat{\beta}$ are determined by the least squares method,

$$\sum_{t=1}^{T}\left[r_t - (\hat{\alpha} + \hat{\beta} \cdot P_t)\right]^2 = \sum_{t=1}^{T} \varepsilon_t^2 \rightarrow min. \tag{2.33}$$

Then you can use the parameters $\hat{\alpha}$ and $\hat{\beta}$ to calculate the coefficients a and b,

$$a = -\frac{\hat{\beta}}{dt}, \tag{2.34}$$

$$b = \frac{\hat{\alpha}/a}{dt}. \tag{2.35}$$

The standard deviation is then determined from the equation,

$$\sigma = \frac{\hat{\sigma}}{dt}, \tag{2.36}$$

where $\hat{\sigma}$ is the annualized standard deviation of a tent in a relationship,

$$\hat{\sigma} = \sqrt{\frac{1}{N} \cdot \sum_{t=1}^{T}\left[r_t - \hat{\alpha} + \hat{\beta} \cdot P_t\right]^2} = \sqrt{\frac{1}{N} \cdot \sum_{t=1}^{T} \varepsilon_t^2}. \tag{2.37}$$

Modeling of prices by mean-reversion model can be written as,

$$P_t = P_{t-1} + a \cdot (b - P_{t-1}) \cdot dt, \tag{2.38}$$

from this relationship based model simulation market price, median and quantile value,

$$P_t = P_{t-1} + a \cdot (b - P_{t-1}) \cdot dt + \sigma \cdot \sqrt{P_{t-1}} \cdot d\tilde{z}, \tag{2.39}$$

$$(P_t) = b + (P_{t-1} - b) \cdot e^{-a \cdot n}, \tag{2.40}$$

$$P_T^{\gamma} E(P_T) + \Phi^{-1}(\alpha) \cdot \sqrt{\sigma_E^2}, \tag{2.41}$$

where Φ^{-1} is inverse cumulative distribution function for a confidence level of α and σ_E^2 empirical variance determined from the equation,

$$\sigma_E^2 = \frac{\sigma^2}{2 \cdot \alpha} \cdot (1 - e^{-2 \cdot \alpha \cdot n}). \tag{2.42}$$

2.4 Statistical Model Verification

Within statistical verification is to verify the assumptions basic data set. These assumptions can be called as a statistical hypothesis, i.e. the claim random variable.

The essence of the test is to obtain information about the statistical significance of the calculated parameters of the model (t-test) or the statistical significance of the model as a whole (F-test). The road leading to the decision is called hypothesis testing. The hypothesis that confirms zero parameters is referred to as the null hypothesis; the opposite is the alternative hypothesis.

2.4.1 The Statistical Significance of the Model Parameters

The statistical significance of each parameter is determined by t-test. The test is based on the assumption that the sample mean of a normal distribution, which is deducted from the mean of the distribution and everything is divided by the sample standard deviation, Student has a probability distribution with *df*-degree of freedom,

$$t_{df} = \frac{\hat{\beta}_i - 0}{SE_{\hat{\beta}_i}}, \tag{2.43}$$

where $SE_{\hat{\beta}_i}$ is estimate of standard deviation coefficient $\hat{\beta}_i$.

During the actual testing procedure is such that it is determined null and alternative hypotheses. Hypotheses are tested using decision rules. The null hypothesis H_0 most often assumes that the individual variables are statistically insignificant, i.e., the parameters are equal to zero. An alternative hypothesis H_A then based on the contrary assumption, i.e., the variables are statistically significant. These relationships can be written as,

$$H_0\colon \hat{\beta}_i = 0, \tag{2.44}$$

$$H_A\colon \hat{\beta}_i \neq 0. \tag{2.45}$$

In this test compares the size of the type of statistics t_{vyp} and statistics t_{krit} i.e.,

$$t_{vyp}^{df} = \frac{\hat{\beta}_i}{SE_{\hat{\beta}_i}}, \tag{2.46}$$

$$t_{vyp}^{\alpha/_2, df} = ST_{df}^{-1}(\alpha/_2), \tag{2.47}$$

where ST is the distribution function of the Student distribution and ST_{df}^{-1} is the inverse function on a probability level $\alpha/_2$ degree of freedom is df. Statistics t_{krit} determines percentile t-statistics for a given level of significance α and statistics t_{vyp} corresponds to the estimated value.

Decision rules for the t-test are the rejection or acceptance of the null hypothesis. By rejecting the null hypothesis and the adoption of alternative hypothesis can be represented by a rule-where $|t_{df}^{vyp}| > t_{\alpha/_2, df}^{krit}$, then we reject the null hypothesis. Or use the rule that if $P_{df} < \alpha$, where $P_{df} = \alpha_{vyp} = ST_{df}(t_{df}^{vyp}) \cdot 2$, then the null hypothesis is rejected. This means that the adjusted coefficient located in the critical area, is statistically significant and should be included to the estimated model.

2.4.2 The Statistical Significance of the Whole Model

If we want to test the significance of the entire model, then *F*-test is an option to achieve this. Also, we have two hypotheses:

Null hypothesis, $H_0: \hat{\beta}_0 = \hat{\beta}_1 = 0$, (2.48)

Alternate hypothesis, $H_1: \hat{\beta}_0 \neq \hat{\beta}_1 \neq 0$ (2.49)

The test is constructed on the basis of the *F*-statistic providing that the statistic is of the Fisher distribution,

$$F = \frac{ESS/df_{ESS}}{RSS/df_{RSS}} = \frac{MS_{ESS}}{MS_{RSS}}, \tag{2.50}$$

where *ESS* is the Explained Sum of Squares (variance explained by the regression), *RSS* is the Residual Sum of Squares (variance unexplained by the regression), MS_{ESS} is the Mean Square Explained and MS_{RSS} is the Mean Square Residual, df_{ESS} and df_{RSS} are degrees of freedom assigned to variances, $df_{ESS} = k + 1$, $df_{RSS} = T - (k + 1)$, where k is the number of independent variables. Here we add 1, since the degree of freedom is influenced also by the intercept constant (if it is part of the model).

The evaluation is based on the comparison of the calculated value of statistic, F^{calc}, and the critical value of the statistic, F^{crit}, where it is assumed that the *F*-statistics is distributed according to the Fisher's distribution.

$$F^{calc}_{df_{ESS};df_{RSS}} = \frac{MS_{ESS}}{MS_{RSS}}, \tag{2.51}$$

$$F^{crit}_{\alpha;df_{ESS};df_{RSS}} = FISH^{-1}_{df_{ESS};df_{RSS}}(\alpha), \tag{2.52}$$

where $FISH$ depicts the distribution function of the Fisher's distribution and $FISH^{-1}_{df_{ESS};df_{RSS}}$ is its inverse function (quantile) on the probability level α.

$$ValueP_{df_{ESS};df_{RSS}} = \alpha^{calc} = FISH_{df_{ESS};df_{RSS}}(F^{calc}). \tag{2.53}$$

The decision rule for the one-tailed F-test can be formulated in following ways.

If $F^{calc}_{df_{ESS};df_{RSS}} > F^{crit}_{\alpha;\, df_{ESS};df_{RSS}}$ or $ValueP_{df_{ESS};df_{RSS}} < \alpha$, then we reject H_0. If $F^{calc}_{df_{ESS};df_{RSS}} \leq F^{crit}_{\alpha;\, df_{ESS};df_{RSS}}$ or $ValueP_{df_{ESS};df_{RSS}} \geq \alpha$, then we can accept H_0. The rejection of the null hypothesis means that the estimated model is statistically significant and the statistical dependency between random variables R_i and R_M is confirmed. The acceptance of H_0 means the opposite conclusion.

2.5 Quantification of Risk

The most commonly used approach for managing financial risk VaR methodology. The method is defined as the smallest predicted loss for a given probability level for the given time interval.

Risk is the uncertainty associated with the occurrence of certain situations. In practice, there are a number of risks:

Financial risk – is an unexpected loss, which is the reason for determining to regulate the risk-weighted capital. Financial risk is also perceived as a negative volatility of financial markets.

Business risk - the risk of specific markets and sectors in which the company operates. Business risk includes a number of other risks, for example, risk of competition, reputation, disaster, tax, currency convertibility, and so on.

Strategic risk - is caused by changes in economic and political environment.

Credit risk - is characterized by the inability of institutions to meet their obligations.

***Financial Risks*[3]**

Financial risks can be categorized as follows:

1. **Market risk**, which is manifested by changes in prices of assets and liabilities. Within the market risk VaR methodology is applied. Market risk can be characterized by other financial risks, which varies according to changes in the sensitivity of individual instruments. Most often it is the risk of interest rate, currency, equity, commodity, correlation and credit spread risk.
2. **Credit risk** that characterizes the risk of loss due to inability to meet the agreed terms of the contract. Credit risk can be further broken down into direct credit risk, credit equivalents, changes in credit ratings, settlement risk and credit exposure risk.

[3] CIPRA, T.; Finanční ekonometrie. 1. vyd. Praha: Ekopress, 2008. 240 s. ISBN 978- 80-86929-43-9.

3. **Liquidity risk** is the risk of loss due to lack of cash funds, which can take two forms, namely the risk of market liquidity and funding.
4. **Operational risk** is the risk of loss due to errors internal operating systems, or people who work with them. It can have various forms, particularly transaction risk, and operational risk management system.
5. **Legal risk** arises from the legal enforceability of contract or breach of legal requirements counterparties.

2.5.1 Principle of VaR

VaR methodology estimates the worst loss that can occur with a specified probability in a given term. This value is then used to measure various financial risks. Results VaR can be used in various ways:

- For determining capital requirements;
- For allocation of investment resources;
- For evaluating individual traders;
- For illustrative and operational information;
- For financial risk management;
- For integrating different types of risk into a single value.

VaR method specifies the factors, which must be determined in advance. These factors include:

- Time horizon that specifies what period is considered possible loss. The time horizon is influenced by a number of circumstances, for example, market liquidity portfolio permanence or verifiability results;
- Reliability that specifies how likely does not exceed the actual loss of expected loss;
- Frequency of the observation;
- Distribution function, which must be estimated from data entered;
- Value of financial position, which corresponds to the current market valuation considered asset or portfolio.

The probability that a portfolio of assets will be profitable, expressed as $\Delta\tilde{\pi}$, and this profit will be less than the predetermined level of profit is equal specified confidence level α, respectively. VaR expresses a loss, and we know that profit can be expressed as a negative loss, particularly as,

$$\Pr(\Delta\tilde{\pi} \leq profit) = \alpha, \tag{2.54}$$

Or alternatively,

$$\Pr(\Delta\tilde{\pi} \leq -VaR) = \alpha. \tag{2.55}$$

The VaR-based loss is then expressed by the formula,

$$\Pr\left(\widetilde{Loss} \geq Loss\right) = \alpha, \tag{2.56}$$

Or alternatively,

$$\Pr\left(\widetilde{Loss} \geq VaR\right) = \alpha. \tag{2.57}$$

A prerequisite for the criterion is that the probability distribution is normal and also a function of the random variable is always linear. VaR is then possible to deduce from equation (2.55), i.e. $\Pr(\Delta\tilde{\pi} \leq -VaR) = \alpha$. To simplify criteria is introduced assumption that the random variable evolves according to a random distribution, i.e., the implementation of pay,

$$g = \Delta\Pi + VaR, \tag{2.58}$$

$$\Pr(\tilde{g} \leq 0) = \alpha. \tag{2.59}$$

To work with a normal distribution, the above relationship standardized. If the mean value is equal to 0 and a variance equal to 1, the relationship may be expressed as,

$$Pr\left[\frac{\tilde{g}-E(\tilde{g})}{\sigma(\tilde{g})} \leq \frac{0-E(\tilde{g})}{\sigma(g)}\right] = \alpha. \tag{2.60}$$

Since the distribution function of the standard - normal distribution applies that $\Pr(\Delta\tilde{\pi} \leq z) = \alpha$, which may be written as $\Phi(z) = \alpha$, when using the inverse function, this formulation can be written as $z = \Phi^{-1}(\alpha)$, can be obtained by substitution that can be expressed by equation,

$$\frac{\tilde{g}-E(\tilde{g})}{\sigma(\tilde{g})} = \Phi^{-1}(\alpha), \tag{2.61}$$

adjustments can obtain the relationship,

$$-\mathrm{E}(\tilde{g}) = \Phi^{-1}(\alpha) \cdot \sigma(\tilde{g}), \tag{2.62}$$

after completing the resulting back-substitution can be expressed as,

$$-VaR + E(\Delta\pi) = \Phi^{-1}(\alpha) \cdot \sigma(\tilde{g}), \tag{2.63}$$

which is in the final stage of VaR expressed as follows,

$$VaR = -E(\Delta\pi) - \Phi^{-1}(\alpha) \cdot \sigma(\Delta\pi). \tag{2.64}$$

2.5.2 Calculating VaR

Determine risk via using VaR is possible in several ways. The basic methods may include in particular the method of Monte Carlo simulation, analysis and historical.

Analytical Method

This method belongs to the group parametric linear VaR models. Works with normal distribution of yields and portfolio risk factors are identified as linear.

Using parametric linear models when using an analytical form, which is associated with parametric distribution of income, to quantify the value of VaR. This method is efficient and relatively quick, and it is suitable for larger portfolio. In the case of multidimensional linear VaR model dependence of individual risk factors expressed correlations (interdependence).

Historical Method

Historical method or historical simulation model is a nonparametric method, which does not specify the distribution of risk factors. It is based on historical data and design VaR is performed based on the transfer of development until now.

The method is sometimes also referred to as the so-called. Lacing method ("bootstrapping"), because it is an important prerequisite for the application of the current (current) distribution on historical data.

The individual k-scenarios are estimated from historical data. The application of the abovementioned method for calculating the VaR is needed large amounts of historical data and historical method is somewhat intuitive.

Monte Carlo Simulation

Monte Carlo simulation is a very flexible tool for risk measurement.

One of the key steps simulations Monte Carlo is the existence of so-called. Pseudorandom numbers. Random numbers can be described as a process where the program creates random numbers. The value of these numbers belong to the interval (0,1), each i-th number is j-th independent and non-repeating in a given algorithm. It is necessary, however, to apply that $i \neq j$.

The sequence of random numbers is unique, i.e. that for repeat attempts to generate random numbers is not possible to achieve the same composition numbers.

Another important step is the selection of suitable stochastic process, which is modeled on the likely future development of revenues, asset prices and exchange rates of ATP. One of suitable processes is Brownian process.

This method is the simplest of these. The result obtained should be comparable as when applying a normal linear VaR method.

The actual method or Monte Carlo stochastic simulation consists of three steps:

1. Generating scenarios;
2. Risk assessment;
3. Summaries, which are expressed simulation results either in the form of division probability or fixed levels of risk.

3. Characterization of the Air China Company

To give you a better understanding of our selected company, we are going to introduce you to Air China Company in more details. Hence, four main aspects are chosen being described as follows:

- Overview of Air China Company;
- Historical description of Air China Company;
- SWOT analysis of Air China Company;
- Airline industry analysis in China.

3.1 Overview of Air China Company

Literally, Air China Company is called " China International Airlines Company" As its name implies, Air China Company is the biggest state-owned aviation enterprise in the People's Republic of China. Moreover, Air China is also the only national flag carrier of China. Air China's headquarters are in Shunyi District, Beijing; and its operations are based out of Beijing Capital International Airport. The idea of Air China's logo originates in an artistic phoenix pattern, which is designed as an example in image 3.1.

Image 3.1 Logo of Air China Company

Source: http://www.boodaiaviation.com/en/airchina.html

In ancient China, the phoenix is one of the most powerful legends; it is a symbol of heaven's favor, representing virtue, grace, luck and happiness. That is the main reason why Air China Company chose phoenix as auspicious wishes for bringing peace and pleasure to everyone all over the world. From an artistic point of view, this logo is also the deformation of the English word "**VIP**" (abbreviated form of **Very Important Person**), to show its respects for every passenger.

3.2 Historical description of Air China Company

The former Air China was established on July 1, 1998 as a result of the Chinese government's decision in late 1987 to split the Civil Aviation Administration of China (CAAC) into six separate airlines: China Eastern, China Southern, China Northern, China Southwest, China Northwest and Air China. At that time, Air China was only responsible for international flights.

Before 2001, Air China was the country's fourth largest domestic airline. In response to " Civil Aviation System Reform Program" in October 2002, the former Air China consolidated with China Southwest Airline, China National Aviation Company and Founded China Aviation Group Company. After that, the new Air China Company was officially established. Air China was chosen as the company to take responsibility for providing special flight services for Chinese national leaders visiting abroad, and foreign leaders or government officials visiting China.

On December 15, 2004, Air China was successfully listed on the Hong Kong and London Stock Exchange. The airline also listed its shares on the Shanghai Stock Exchange on August 18, 2006.

In 2006, Air China signed the contract to join the Star Alliance[4]. It became a member of the alliance on December 12, 2007 alongside Shanghai Airlines.

In April 2010, Air China successfully completed the increase of shareholding in Shenzhen Airline and became the controlling shareholder of Shenzhen Airline.

On December 2, 2010, as the first foreign airline, Air China received Spain's highest tourism industry award, which is given to organizations or individuals contributing to the Spanish tourism industry.

[4] The Star Alliance is the world's largest global airline alliance, headquartered in Frankfurt am Main, Germany.

On December 23, 2010, Air China Company became the first Chinese airline to start selling combined tickets that include domestic flights and shuttle bus services to nearby cities in order to offer these conveniences to passengers.

On November 15, 2011, Air China became the first airline to offer Wi-Fi Internet service on board its aircraft.

In 2012, considering the pressure from PETA[5], Air China stated that it would no longer transport monkeys to laboratories.

3.3 SWOT analysis of Air China Company

SWOT analysis is a fundamental analysis to identify practice and critical factors that can represent the current situation and influence the future decision-making of the selected company. Generally, we split into four main parts to evaluate a company: Strengths and weaknesses are chosen as internal origins that can influence the company; Oppositely, opportunities and threats represent external elements of the company's management implementation. To make it clear, we can make a matrix in Figure 3.2.

Image 3.2 Matrix of SWOT Analysis

Source: http://www.ethosdebate.com/2015/03/how-to-improve-swot-your-ballots/

Combining our selected company Air China with SWOT analysis, we can summarize Air China Company's Strengths, weaknesses, opportunities and threats.

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[5] PETA-**People for the Ethical Treatment of Animals** is an American animal rights organization. Its slogan is "animals are not ours to eat, wear, experiment on, use for entertainment or abuse in any way."

Strengths

First, Air China is the largest air carrier in China in terms of traffic volume and company assets. The debt to asset ratio of this company is low, which is around 45%. Air China has a huge fleet; over 20 000 employees are working for Air China, including more than 2 300 pilots and 4 520 flight attendants. They are all well trained and professional. Air China owns the newest repairs and maintenance technical systems, and its information network systems are the most advanced Chinese airlines. Due to its long history and good reputation in both international and domestic markets, Air China has gained many loyal frequent flyers from all over the world. Passenger groups continue to increase rapidly in recent years.

Weaknesses

a) Problems caused by Large Size

On one side, Air China has a strong ability to tide over difficulties, but on the other side, its large size causes a low cost performance and operational efficiency.

b) Service Quality Issue

When having an overview of Chinese airline industry, there exists a common problem in every airline company, which is service quality. It is caused by not only the development history of Chinese airline industry but also the qualification of the whole nation.

c) Sale Channels Pressure

Chinese aviation market experienced three important stages: regulated, growth, and maturity. Before 1992, tickets sales basically relied on the government. After 1992, the growth stage came; the establishment of local airlines had entered the market, and agents were everywhere. Travel agencies also sought to enter the civil aviation market. Overall, it was a chaotic channel marketing stage. After 2000, foreign investments entered into the Chinese tourism market, and distribution channels were integrated via joint sharing, and capital restructuring. Airline industry began to enter the stage with orderly competition. However, the airline companies depended too much on agents. The solution on how to deal with the high cost of hiring sales agents and imperfectly channel system is going to be a big issue for Air China Company.

Opportunities

Since 2003, China's economy has been increasing rapidly; the GDP increases 10.4% annually, which is much higher than the world average GDP growth rate (4.9%). Besides, the China airline industry is growing faster than the GDP increase, and the trend is predicted to continue to at least 2017. Nowadays, the relationship among countries is getting tighter and closer, and worldwide deregulations make the skies more accessible. More and more foreign visitors and investors are visiting and investing in China, which make complementary industries like tourism's demand for airline services increase as well. Also, people have more disposable income to travel and choose quality services, which offer Air China a good chance to meet consumers' needs.

Threats

Finally, let's focus on Air China's threats. As an airline company, Air China's main business is strongly connected with transportation. Hence, the jet fuel price plays an important role in Air China's daily operations. Generally, airline companies in China must purchase the jet fuel abroad, so we have to consider the exchange rate issue and also fuel cost issue. There exits a huge uncertain factor that can influence the companies' costs. For example, the financial crisis in 2008 caused the American economy to go into a great depression, which influenced the jet fuel supply for Air China Company. The industry's internal competition is another treat for Air China. With the rapid growth of the Chinese economy, many small airline companies have been formed, which puts Air China under a lot pressure. If we regard airline industry as a big group, the substitute industries like bus industry or train industry are also a big threat for not only Air China Company but also the whole airline industry.

In summary, we can make a clear table to show our SWOT analysis.

Table 3.1 SWOT analysis of Air China Company

Internals / Externals	**S-Strengths** S1-Debt to asset ratio S2-Fleet S3-Technical level S4-Airline network S5-Passenger groups	**W-Weaknesses** W1-Cost performance W2-Operational efficiency W3-Service quality W4-Sale channels
O-Opportunities O1-Macroeconomic development O2-Aircraft industry development O3-Consumer purchasing power O4-Complementary Industry	**SO strategy** 1. Increasing cooperation with foreign airlines; 2. Strengthening brand building to improve its market competitiveness.	**WO strategy** 1. By using its brand advantage to hire the right talented employees; 2. Seizing the potential opportunities to accelerate the pace of its development.
T -Threats T1-Jet fuel supply T2-Industry competition T3-Substitute industry	**ST Strategy** 1. Taking advantage of Air China Company's system to increase its marketing capability; 2. Continuously improving its safety management and products quality.	**WT strategy** 1. Enhancing its cooperation with large group to gain more resources; 2. Strengthening cooperation with foreign airlines to improve its competitiveness in international market.

Considering the current situation about Air China Company and the worldwide economy, we suggest that the Air China Company choose SO strategy to improve its cooperation with foreign airline companies and strengthen its brand building.

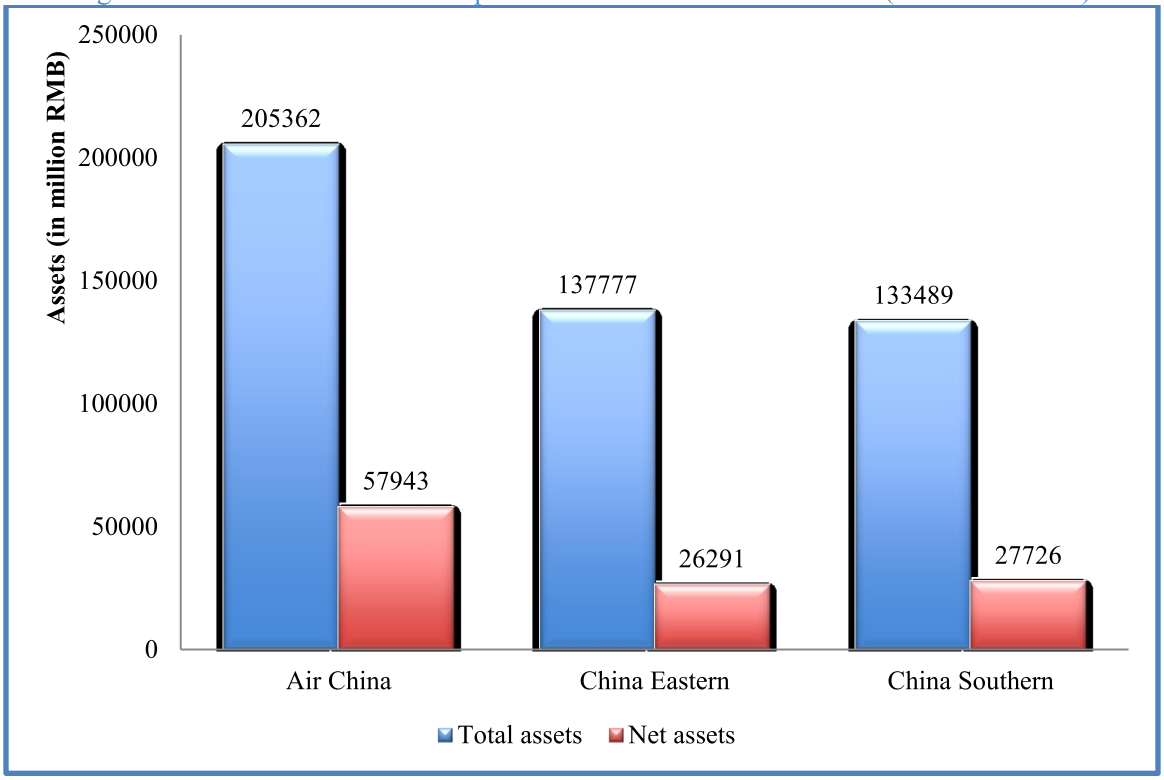
3.4 Airline industry analysis in China

Having an overview of airline industry in China, Air China is always regarded as the most competitive and profitable airline company. Its core competitiveness can be proved in three main aspects: high asset quality, excellence in business management and high market share in China.

3.4.1 High asset quality

One advantage of Air China is the size of its net assets. In China airline industry, Air China has the highest net assets among the main competitors, such as China Eastern and China Southern. From those three largest airline companies' annual reports in 2013, the Air China's net asset reached around 57 943 million RMB, which was two times higher than the net of both China Eastern and China Southern. Graphically, we can see the sample data in 2013 as follows,

Figure 3.1 Three main airline companies' assets information in 2013 (in million RMB)

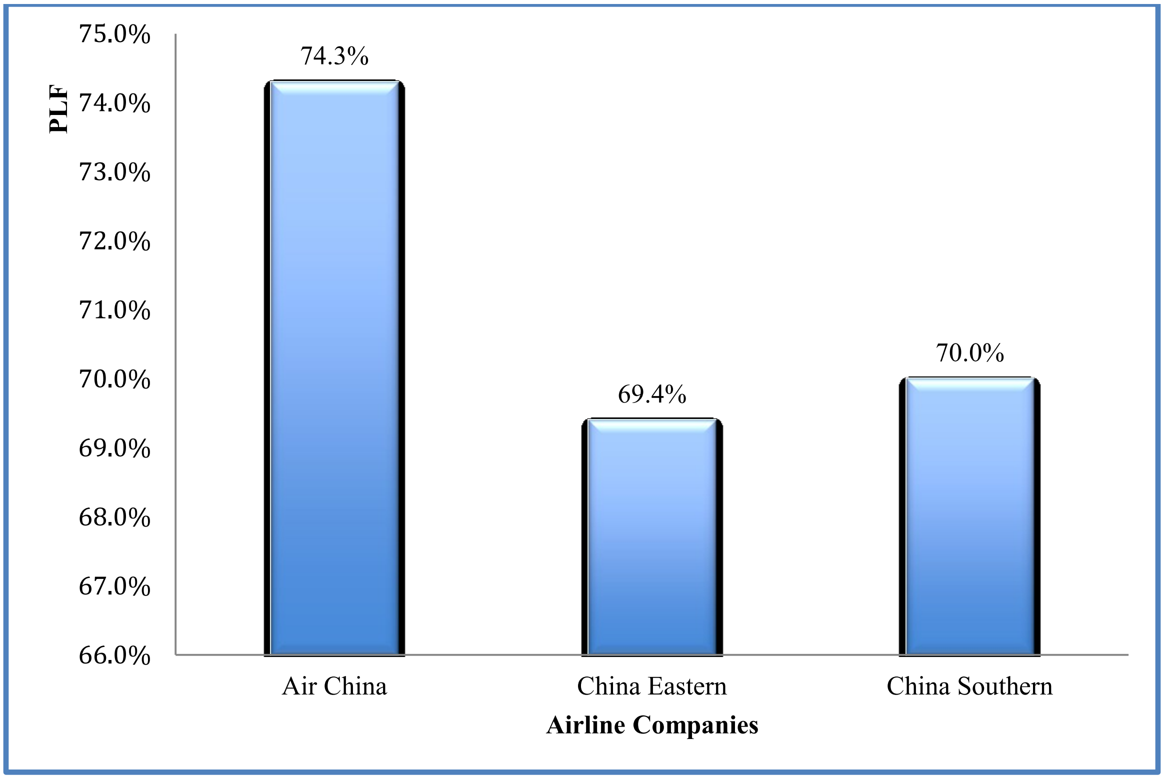


With having a large scale of net assets, it is much easier for Air China to reduce its debt to asset ratio and save financial costs, which can be transferred as Air China back-up power to expand its services.

3.4.2 Excellence in business management

When measuring an airline company's business management and its operational efficiency, we generally would like to take PLF (passenger load factor) as into account.

Figure 3.2 Passenger load factor (PLF) in 2013

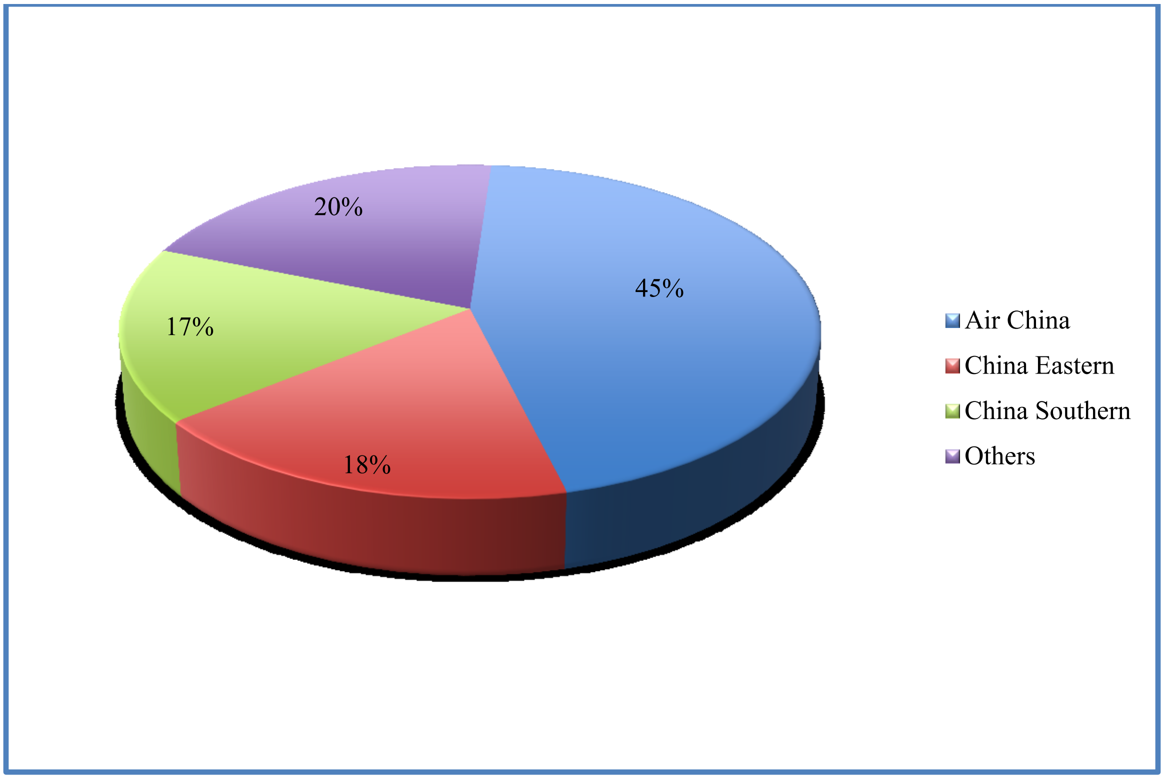


Here we can see that Air China's passenger load factor is much higher than China Eastern and China Southern. Air China Company has a higher operational efficiency compared to its main competitors in Chinese aviation market.

3.4.3 High market share

Finally, we set Beijing market as our small sample to show you three main airline companies' market shares.

Figure 3.3 Aviation market shares in Beijing market



As a capital city in China, Beijing has one of the busiest transportation networks. That is the main reason why we chose Beijing aviation market to show those three main airline companies' market shares. From 2011 on, Air China, China Eastern and China Southern, being the first three largest airline companies, have totaled almost 80% of the aviation market share in China. Where, Air China itself has around 45% of the market share, each of the other two companies only have 17% market share. We can say that Air China has a huge advantage in Chinese aviation market and obviously industry leading status.

4. Application of CorporateMetrics Methodology

In this application chapter, we will apply CorporateMetrics methodology in Air China Company. The main target in this chapter is to estimate the earnings in predicted year 2014 and 2015 at different level of risks; make a prediction about Air China Company's net profit in upcoming 2014 and 2015.

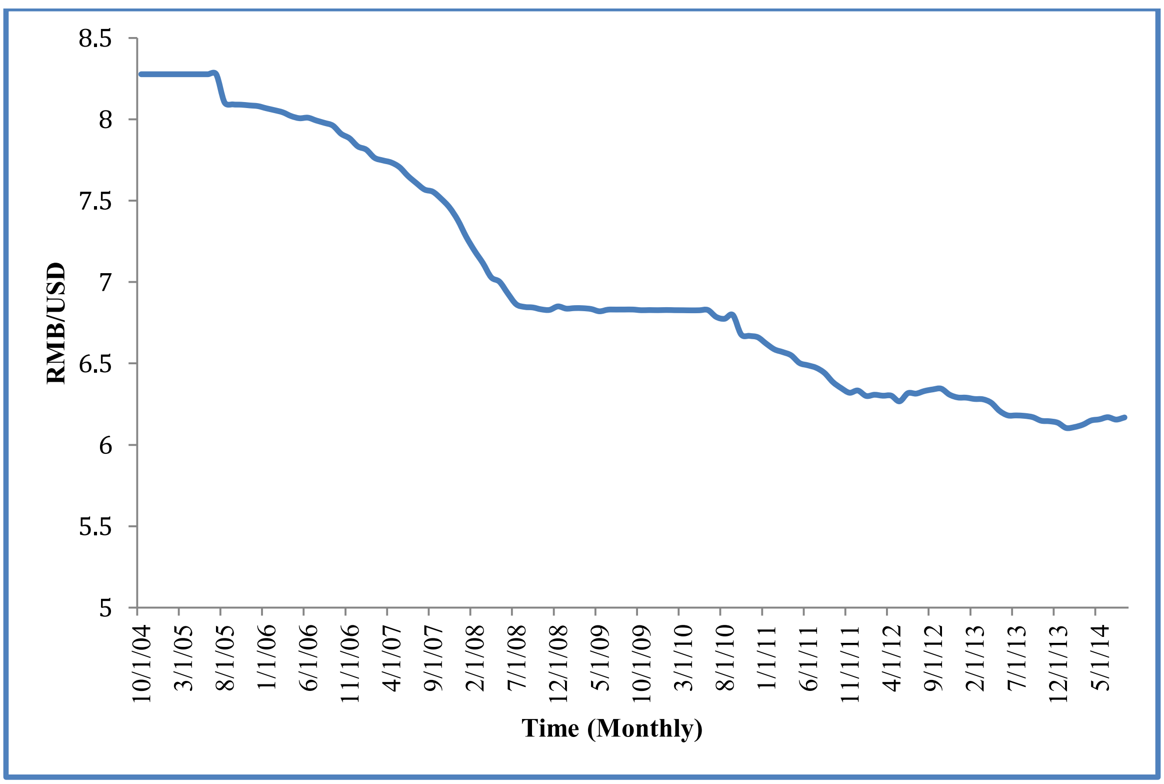
4.1 Market Exchange Rate Prediction

In order to predict the market exchange rate, first of all, we have to find out the basic trend of our selected exchange rates between October 2004 and August 2014. And then, we will select a relevant model to make a prediction of exchange rate for next 2 years, expressed in monthly.

4.1.1 Historical Trend of Market Exchange Rate

When making a figure of historical market exchange rate, we must select a time interval. Here, we choose a period that is between October 2004 and August 2014 as our sample size. From the Internet, we can easily get data and make a Figure 4.1.

Figure 4.1 Monthly exchange rate of RMB/USD from October 2004 to August 2014



From Figure 4.1, all exchange rates in this period are positive and the trend of the selected data keeps decreasing. Then, the Geometric Brownian motion is regarded as our main tool to make a prediction. Considering the formula (2.3), we can easily get mean value (α), standard deviation (σ), interval (Δt) and initial exchange rate (R_0). Here is a Table 4.1.

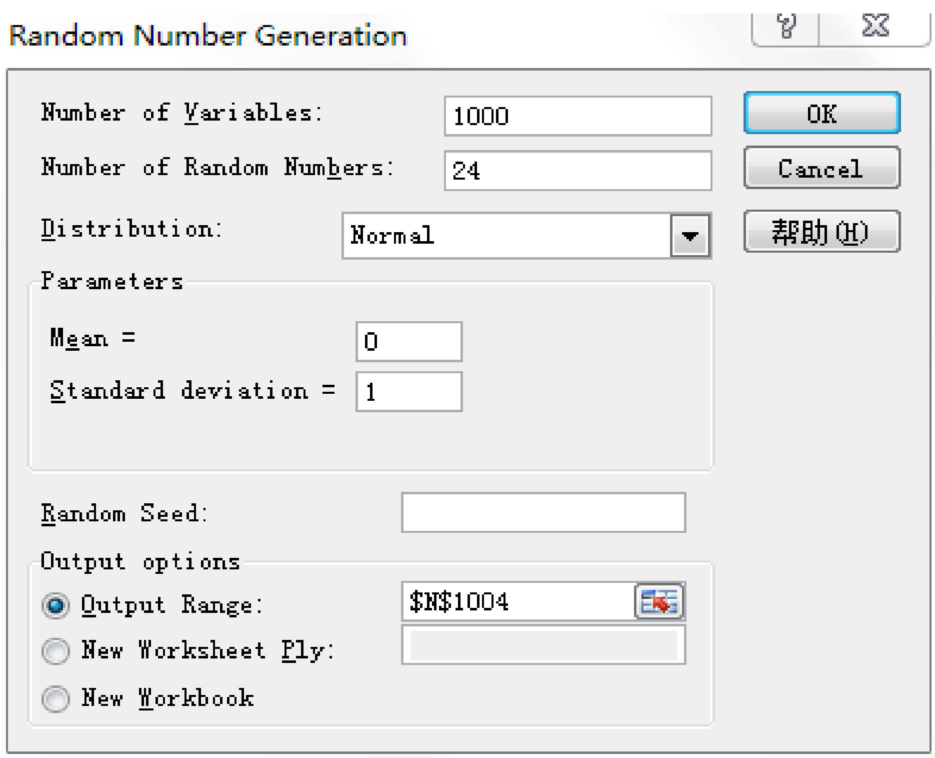
Table 4.1 Parameters for simulating the random evolution of RMB/USD exchange rate

Item	$\boldsymbol{\alpha}$ **(%)**	$\boldsymbol{\sigma}$ **(%)**	$\boldsymbol{\Delta t}$	$\boldsymbol{R_0}$
Number	-0.249	0.421	0.0833	6.168

4.1.2 Simulation of the Random Exchange Rate Evolution

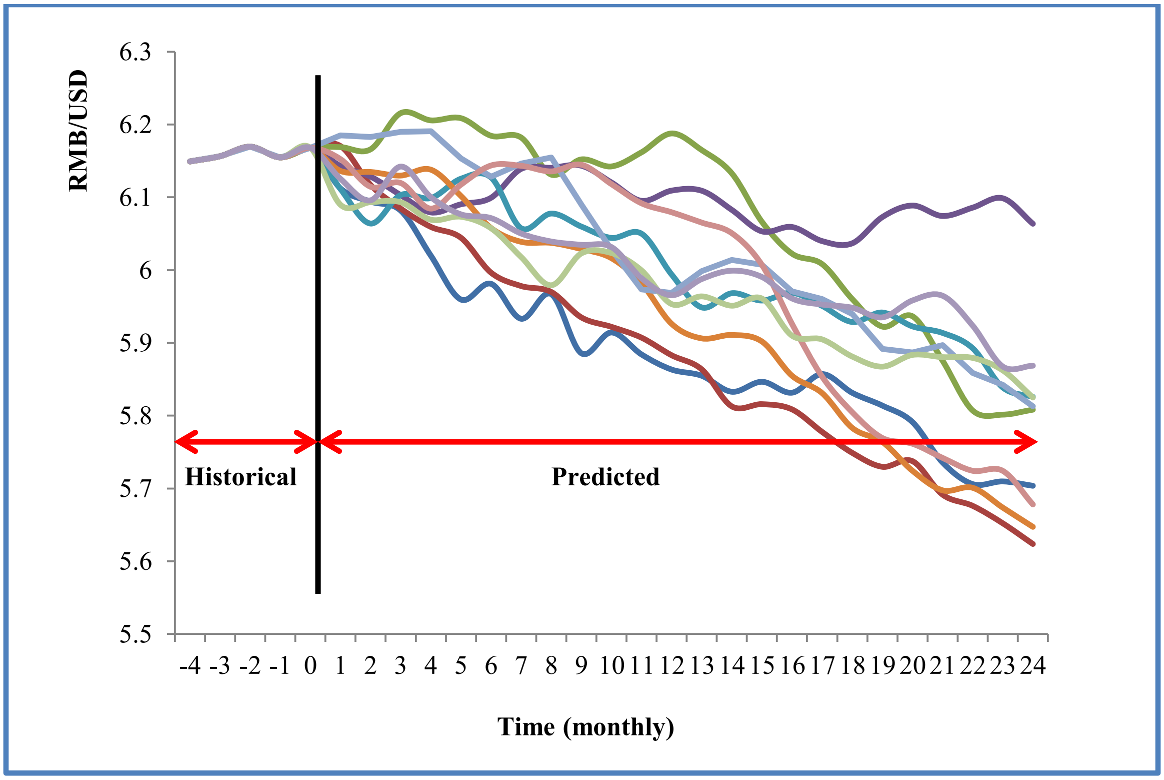
After choosing Geometric Brownian motion as a tool, the first step for us is to generate random values $\tilde{z}$ from the standard normal distribution for each random scenario. The procedure is done by means of the *Random Number Generation* in *Excel*. It can be found as follows: *Tools* → *Data Analysis* → *Random Number Generation.* Here it is:

Figure 4.2 Specifying the *Random Number Generation* for standard normal distribution



The next step is to put data from Table 4.1 and random $\tilde{z}$ into new columns by using formula (2.29) to get the final result. Graphically, it can be expressed in Figure 4.3.

Figure 4.3 Random exchange rate evolution (from August 2013 to 2015)

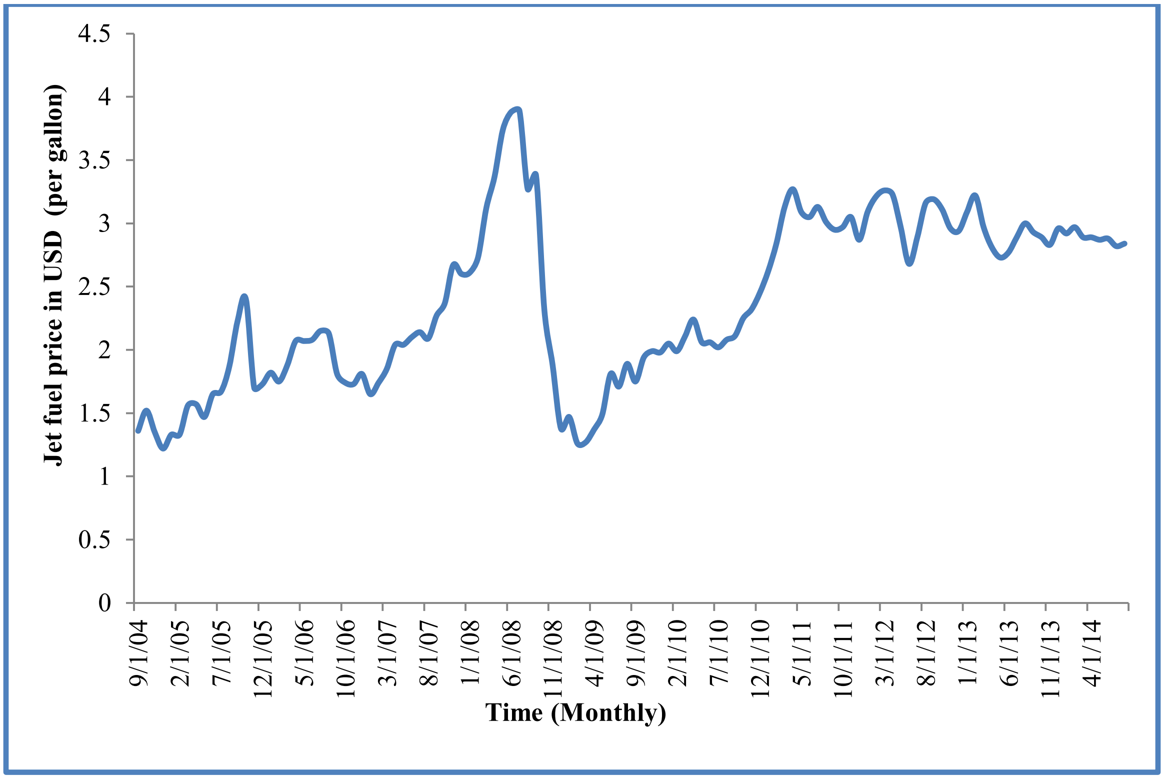


From 1 000 different independent variables, we choose first 10 variables as our observations. In our example, we predict 2 years in the future for every month, which means we have 24 different exchange rates in each month. The "0" on horizontal line means the initial exchange rate $R_0$with 6.1681. Generally, we can see the trend of next 2 years' exchange rate is going down.

4.2 Jet Fuel Market Price Prediction

Due to the reality that jet fuel price changes at every moment. We select the same historical time periods from October 2004 to August 2014. In order to decide what model we will use, the trend of jet fuel price from historical period must be taken into account. Graphically, it can be made in Figure 4.4.

Figure 4.4 Distribution of jet fuel price (from October 2004 to August 2014)

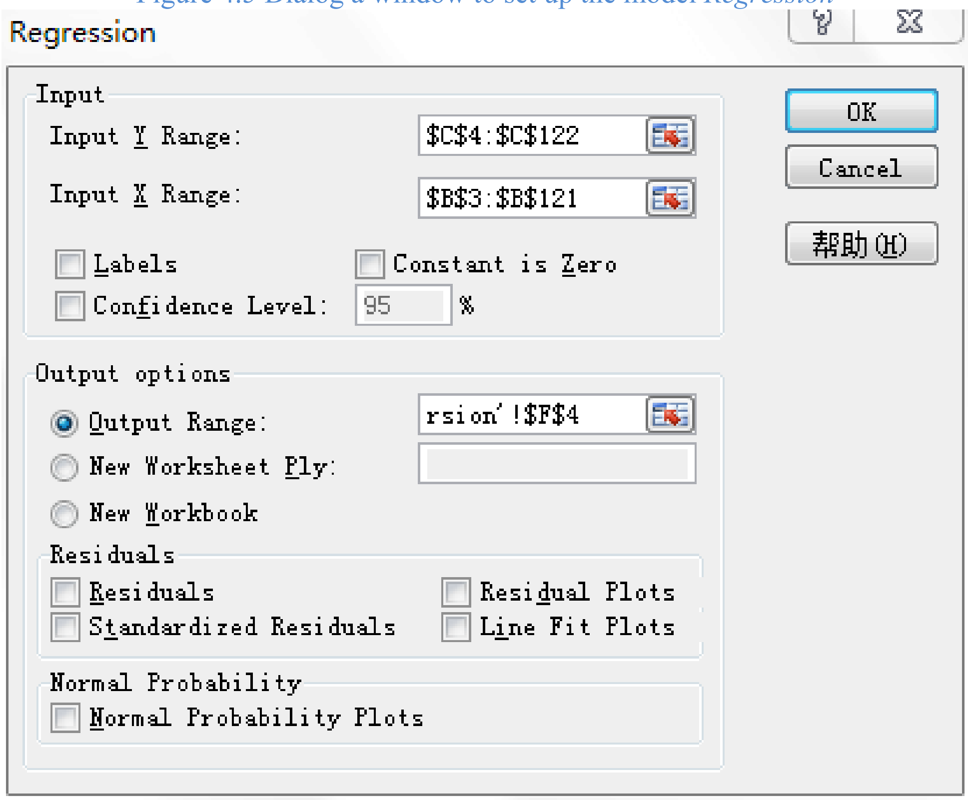


From Figure 4.4, we can easily see that jet fuel price keeps increasing before March 2008 and then there is sharp down. Apparently, the distribution is random and there has a long-term equilibrium line, which can help us choose Vašíček model to make a prediction for jet fuel price in the future.

4.2.1 Regression Analysis

Before calculating parameters ($\hat{\alpha}, \hat{\beta}, \hat{\sigma}, a, b\ and\ \sigma$) , we must use function *Regression* in Excel. The function is: Data → Data Analysis → Regression:

Figure 4.5 Dialog a window to set up the model *Regression*



Where in Figure 4.5, we put relative change of jet fuel price "Δp" (is calculated in Excel via function "LN (p_n/p_{n-1})") into "Input $\underline{Y}$ range" and jet fuel prices from September 2004 to July 2014 into "Input $\underline{X}$ range", and then, click " Output range". After pressing "OK", we can the result of the regression function in Table 4.2.

Table 4.2 Summary output

Regression Statistics	
Multiple R	0.19289257
R Square	0.03720754
Adjusted R Square	0.02897855
Standard Error	0.08766586
Observations	119

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.03474923	0.03474923	4.5215172	0.035572562
Residual	117	0.89918048	0.0076853		
Total	118	0.93392971			

	Coefficients	Standard Erro	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	0.06856305	0.03041494	2.25425593	0.02604135	0.008327863	0.12879824	0.00832786	0.12879824
X Variable 1	-0.0261546	0.01230004	-2.1263859	0.03557256	-0.05051421	-0.001795	-0.0505142	-0.001795

The highlighted two columns can tell us two parameters ($\hat{\alpha}, and\ \hat{\beta}$) in Linear model. The time interval here we assume is in every month, so the parameter Δt is 0.0833[6]. Considering the calculation formula (2.34-2.36), we can easily get the result of $\hat{\sigma}, a, b\ and\ \sigma$. The calculated values are included in the following table.

Table 4.3 Outputs of parameters for both Linear and Vašíček models

Linear model			Vašíček model	
Parameter	Value	P-value	Parameter	Value
$\hat{\boldsymbol{\alpha}}$	0.069	0.026	a	0.314
$\hat{\boldsymbol{\beta}}$	-0.026	0.036	b	2.621
$\hat{\boldsymbol{\sigma}}$	0.09		σ	0.301

The discrete type of the Vašíček model estimated by LSM can be formulated below,

$$p_t = p_{t-1} + a \cdot (b - p_{t-1}) \cdot \Delta t + \sigma \cdot \sqrt{\Delta t} \cdot \tilde{z}. \qquad (4.1)$$

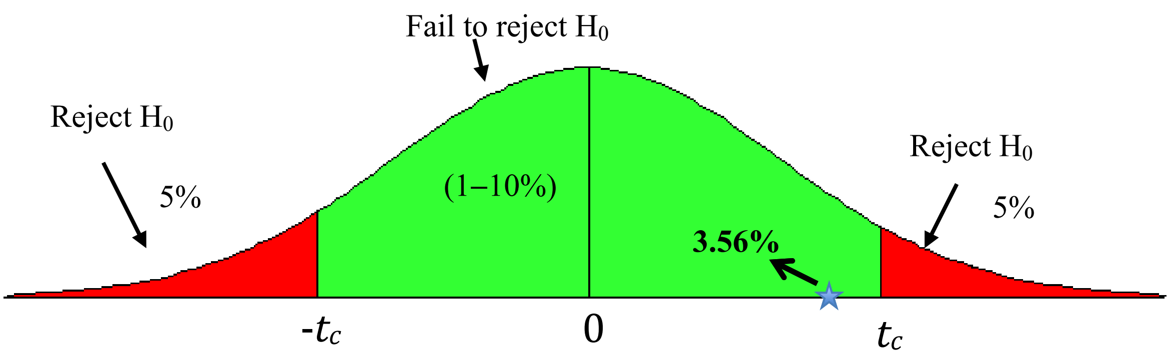
Here we have to mention that the historical jet fuel prices we select are from each month, the prediction of prices will be expressed in monthly data as well. Hence, the parameter "Δt" can be equal to "1". The estimation formula is written as,

$$p_t = p_{t-1} + 0.314 \cdot (2.621 - p_{t-1}) \cdot 1 + 0.301 \cdot \sqrt{1} \cdot \tilde{z}.$$

[6] Δt = 1/12 (when assuming data in monthly)
= 1/250 (when assuming data in yearly, which only concludes working days)
= 1/52 (when assuming data in weekly)

In order to test whether the whole model is statistically significant or not, we must apply a hypothesis test, which is called *F-test*.

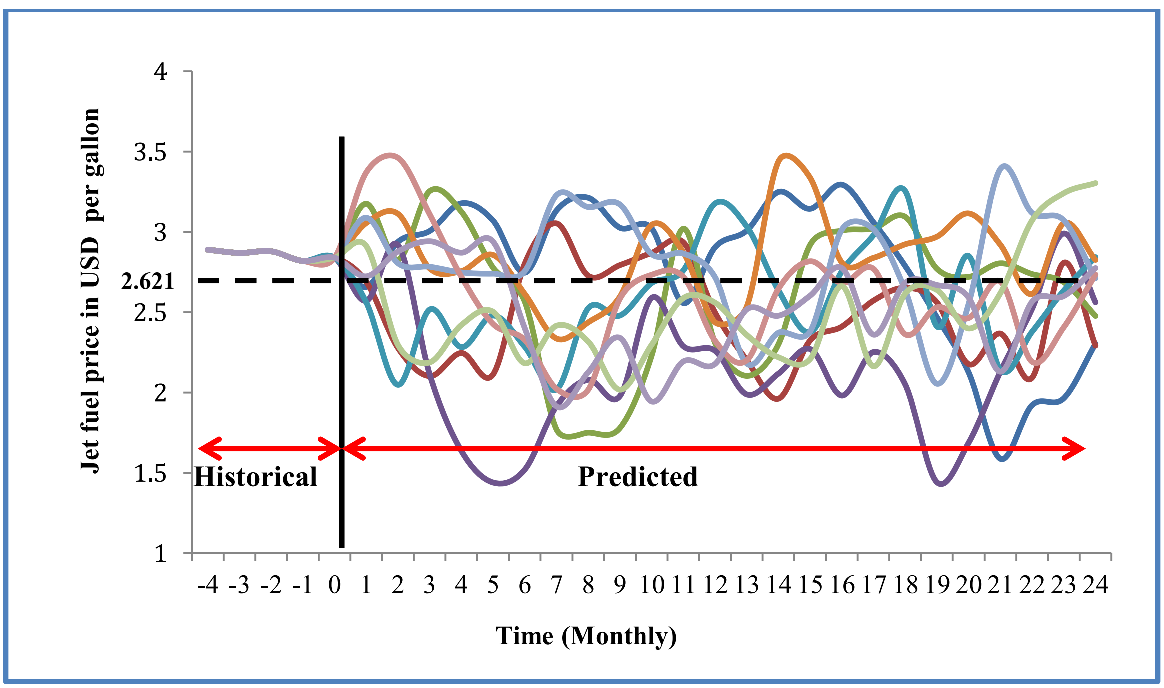
$H_0: \hat{\beta}_0 = \hat{\beta}_1 = 0 \qquad H_1: \hat{\beta}_0 \neq \hat{\beta}_1 \neq 0$



From Table 4.2, we can get the value P (Significance F) as a blue star above is equal to 3.56%, which is smaller than 5%. That means we reject hypothesis H_0, and H_1 is accepted. The whole model is statistically significant.

Due to 1 000 different independent variables, if we assume that the initial jet fuel price is 2.84 USD, we will have 1 000 different distribution lines in every month of 2 years in the future. To make it simple and clear, we also pick out first 10 distribution lines as our observation to draw a graph and observe the general trend.

Figure 4.6 Jet fuel prices evolution in time (from August 2013 to 2015)



From Figure 4.6, we can see there is an equilibrium line with the value 2.621 in a long run. Our selected 10 predicted lines surround this equilibrium line.

4.3 Net Profit Estimation for Air China

4.3.1 Historical Data

When measuring a company's net profit, the prior thing we have to make sure is that the total incomes and expenses of this company. Hence, we summarize an Income Statements table for Air China Company during previous 6 years from its annual reports.

Table 4.4 Income statements from 2008 to 2013 (in million RMB)

Items/Periods	2008	2009	2010	2011	2012	2013
Air traffic revenue	50 537	48 092	78 209	93 343	95 319	94 603
Other operating revenue	2 371	3 302	4 278	5 066	5 518	3 578
Finance revenue	1 584	140	1 980	3 361	375	2 265
Jet fuel costs	22 614	14 466	24 096	34 703	35 638	33 722
Take-off, landing and depot charges	5 538	5 789	7 707	8 741	9 185	9 585
Depreciation	6 365	7 051	8 569	9 561	10 376	10 937
Aircraft maintenance, repair and overhaul costs	1 804	1 768	2 577	2 613	3 259	3 064
Employee compensation costs	5 844	6 627	9 852	12 270	13 648	14 024
Air catering charges	1 444	1 519	2 044	2 663	2 843	2 572
Aircraft and engine operating lease expenses	2 400	2 319	3 488	3 932	3 486	4 006
Other operating lease expenses	448	478	712	669	740	915
Other flight operation expenses	4 666	4 532	8 228	9 343	6 886	8 257
Selling and marketing expenses	2 603	3 085	4 603	5 481	5 668	5 760
General and administrative expenses	1 089	1 016	1 638	2 262	898	1 221
Finance costs	2 049	1 198	1 449	1 594	2 411	2 688

4.3.2 Predicted Data of Fixed Components

Before predicting each item from Income Statements in next 2 years, first of all, we must figure out which one belongs to fixed item and which one is a variable item. So, the diversification table 4.5 can be made.

Table 4.5 Fixed component items diversification

	Fixed items	Variable items
Revenues	Other operating revenue Finance revenue	NA
Costs	Depreciation Employee compensation costs Selling and marketing expenses General and administrative expenses Finance costs	Take-off, landing and depot charges Aircraft maintenance, repair and overhaul costs Air catering charges Aircraft and engine operating lease expenses Other operating lease expenses Other flight operation expenses

4.3.2.1 Weighted Average method

Firstly, we will make a prediction for those fixed items. Let's assume that the sum of those items will not change in next 2 years. Depending on Weighted Average method, we specify each year in historical period as different weights. From latest year 2013 to year 2008, the weights for each year are 6, 5, 4, 3, 2 and 1. By using formula,

$$\frac{w_1 \cdot x_1 + w_2 \cdot x_2 + \cdots w_n \cdot x_n}{\sum_{t=1}^{T} w_n}. \tag{4.2}$$

where w_n is weights at different times, x_n means those selected fixed costs in different years from 2008 to 2013, we can get the results of each fixed cost in year 2014 and 2015 in Table 4.9 and Table 4.10.

4.3.2.2 Ratios Calculation

Now, we are going to predict the results for those variable items. Before, we have an assumption that the annual growth rate for air traffic revenue is 2% in the future. Due to the reality that air traffic revenue is the main source of revenue in Air China Company. Hence, we use each variable item divided by air traffic revenue to get a ratio table.

$$\% = \frac{x_n}{Revenue_n}. \tag{4.3}$$

Table 4.6 Historical variable costs ratio calculations based on revenues (%)

Items	2008	2009	2010	2011	2012	2013
Aircraft maintenance, repair and overhaul costs	3.6	3.7	3.3	2.8	3.4	3.2
Take-off, landing and depot charges	11.0	12.0	9.9	9.4	9.6	10.1
Air catering charges	2.9	3.2	2.6	2.9	3.0	2.7
Aircraft and engine operating lease expenses	4.7	4.8	4.5	4.2	3.7	4.2
Other operating lease expenses	0.9	1.0	0.9	0.7	0.8	1.0
Other flight operation expenses	9.0	9.0	11.0	10.0	7.0	9.0

To make it clearer and easier, we pick out each of items' average ratio among those 6 years as our basic calculated ratios.

Table 4.7 Average ratios of each historical variable cost (2008-2013)

Items	Average (%)
Aircraft maintenance, repair and overhaul costs	3.3
Take-off, landing and depot charges	10.3
Air catering charges	2.9
Aircraft and engine operating lease expenses	4.4
Other operating lease expenses	0.9
Other flight operation expenses	9.2

Next step, we separately use each variable item to multiply the sum of air traffic revenue in the same year to get the results of those variable items. By using the same process, we can easily get those variable items' results in year 2015.

4.3.2.3 Time Periods Diversification

To make our prediction more accurate, we decide to estimate each quarter of results in year 2014 and 2015. That means we will have 4 different numbers in 2014 and also 4 different numbers in 2015. In order to decide how high the proportions are for each quarter in every year and consider the reality that the efficiency of Air China Company's operating activity in 2nd quarter is higher than any other 3 quarters. Hence, we assume the proportion in 2nd quarter is 0.4; the proportion in 1st quarter is 0.15; the proportion in 3rd quarter is 0.2 and the proportion in last quarter is 0.25. In summary, the total proportion must be equal to 1.

Table 4.8 Proportion for each quarter in 2014 and 2015

1	**2**	**3**	**4**	**Sum**
0.15	0.40	0.20	0.25	1.00

Excluding the special item "jet fuel costs", the predicted income statement can be shown in Table 4.9 and Table 4.10.

Table 4.9 Income statements in 2014 (Predicted in quarterly)

Revenues	**Quarter of 2014** 1	2	3	4	**SUM**
Air traffic revenue	14 195	37 853	18 926	23 658	94 632
Other operating revenue	1 085	1 085	1 085	1 085	4 340
Finance revenue	617	617	617	617	2 468
Jet fuel costs					
Take-off, landing and depot charges	1 466	3 910	1 955	2 444	9 776
Depreciation	2 564	2 564	2 564	2 564	10 256
Aircraft maintenance, repair and overhaul costs	473	1 262	631	789	3 154
Employee compensation costs	3 402	3 402	3 402	3 402	13 606
Air catering charges	407	1 084	542	678	2 710
Aircraft and engine operating lease expenses	618	1 649	824	1 031	4 122
Other operating lease expenses	124	331	166	207	828
Other flight operation expenses	1 304	3 479	1 739	2 174	8 696
Selling and marketing expenses	1 390	1 390	1 390	1 390	5 561
General and administrative expenses	386	386	386	386	1 546
Finance costs	516	516	516	516	2 064

(Monetary units for this table is in million RMB)

Table 4.10 Income statements in 2015 (Predicted in quarterly)

Revenues	Quarter of 2015 1	2	3	4	SUM
Air traffic revenue	14 479	38 610	19 305	24 131	96 525
Other operating revenue	1 085	1 085	1 085	1 085	4 340
Finance revenue	617	617	617	617	2 469
Jet fuel costs					
Take-off, landing and depot charges	1 496	3 989	1 994	2 493	9 971
Depreciation	2 564	2 564	2 564	2 564	10 257
Aircraft maintenance, repair and overhaul costs	483	1 287	643	804	3 217
Employee compensation costs	3 402	3 402	3 402	3 402	13 606
Air catering charges	415	1 106	553	691	2 764
Aircraft and engine operating lease expenses	631	1 682	841	1 051	4 205
Other operating lease expenses	127	338	169	211	845
Other flight operation expenses	1 331	3 548	1 774	2 218	8 870
Selling and marketing expenses	1 390	1 390	1 390	1 390	5 561
General and administrative expenses	386	386	386	386	1 546
Finance costs	516	516	516	516	2 064

(Monetary units for this table is in million RMB)

4.3.2.4 Prediction of Jet Fuel Costs

There is a special variable item, which is jet fuel costs. When measuring this important factor, firstly, we must consider the floating jet fuel costs; normally, the Air China purchases jet fuel from the United States of America, so another very important step is to take exchange rate between RMB and USD into account. Let's imagine the jet fuel costs in 2013 is our based number to make a prediction for the future. Then, we can calculate the total quantity of jet fuel the company used in 2013. The detailed data is in Table 4.11.

Table 4.11 Basic information about jet fuel in 2013

	Per gallon of jet fuel (RMB)	Total fuel costs (RMB in million)	Quantity (millions of gallons)
2013	18.118	33 722	465

Here is an assumption that the total quantity of jet fuel Air China Company will use in 2014 and 2015 does not change. The time intervals for exchange rates and jet fuel prices that we predicted are in each month before. However, the jet fuel costs in 2014 and 2015 we want to estimate is only in each quarter. So, when calculation jet fuel cost in every quarter of 2014 and 2015, firstly, when considering the prediction of exchange rates and jet fuel prices, we must put every 3 months into a new time interval. Then, by using every third of each new time interval of exchange rate multiply every third of each new time interval of jet fuel price and multiply fixed total quantity of jet fuel to get the results of each quarter in year 2014 and 2015. The equation for estimating jet fuel costs can be written as,

$$JFC_t^i = MFC_t^i \cdot Q \cdot K_t^i, \quad (4.4)$$

in our case, it should be specified as,

$$JFC_t^i(RMB) = JFC_t^i(USD) \cdot Q \cdot K_t^i. \quad (4.5)$$

where JFC_t^i represents jet fuel cost at time *t*, MFC_t^i means the market fuel cost at time *t*, Q means the quantity of jet fuel and K_t^i represents the exchange rate *K* at time *t*.

Due to 1,000 different independent multipliers, we will get 1,000 different jet fuel costs in each quarter. If we pick out first ten random estimated jet fuel costs as our example, the table can be made in Table 4.12.

Table 4.12 Ten random estimated jet fuel costs in 2014 (in quarterly)

Jet fuel costs	**Quarter of 2014**				**SUM**
	1	2	3	4	
Scenario 1	8 508	7 645	8 290	7 926	32 369
Scenario 2	5 954	7 824	7 716	6 841	28 335
Scenario 3	9 414	7 387	5 095	6 654	28 550
Scenario 4	6 005	4 318	5 657	6 427	22 407
Scenario 5	7 150	6 517	6 994	8 864	29 525
Scenario 6	7 912	7 370	7 288	6 724	29 294
Scenario 7	8 019	7 861	8 988	7 552	32 419
Scenario 8	8 859	6 655	7 391	6 572	29 477
Scenario 9	6 205	6 154	5 657	7 093	25 109
Scenario 10	8 411	6 784	6 575	6 048	27 817

(Monetary units for this table is in million RMB)

Table 4.13 Ten random estimated jet fuel costs in 2014 (in quarterly)

Jet fuel costs	**Quarter of 2015**				**SUM**
	1	2	3	4	
Scenario 1	8 556	7 566	4 240	6 116	26 477
Scenario 2	6 292	7 097	6 271	5 999	25 659
Scenario 3	8 243	8 583	7 670	6 697	31 194
Scenario 4	6 398	5 760	6 022	7 229	25 410
Scenario 5	6 591	8 980	5 897	7 710	29 177
Scenario 6	9 167	7 868	7 744	7 428	32 207
Scenario 7	6 656	7 289	9 310	7 336	30 591
Scenario 8	7 878	6 383	7 194	7 228	28 683
Scenario 9	6 129	7 162	7 167	8 957	29 415
Scenario 10	7 259	7 431	5 914	7 580	28 182

(Monetary units for this table is in million RMB)

4.3.2.5 Frequency Analysis of Jet Fuel Costs

In order to find out the frequency of jet fuel costs from 1 000 different jet fuel costs in each quarter. Firstly, we create 20 new intervals for those 1 000 different jet fuel costs in each quarter. And then, we use Excel function " *MIN*" and "*MAX*" to get the lowest number and highest number for each quarter. By using formula

$$Step = \frac{Max-Min}{N\ (intervals)}. \tag{4.6}$$

to draw 2 tables as follows,

Table 4.14 Frequency analysis factors for each quarter in 2014

Items/Quarters	1st	2nd	3rd	4th
Min	4 243	3 595	3 795	3 178
Max	10 839	10 959	11 095	11 575
Numbers	20	20	20	20
Steps	329.833	368.198	364.999	419.866

(Monetary units for Min and Max values are in million RMB)

Table 4.15 Frequency analysis factors for each quarter in 2015

Items/Quarters	1st	2nd	3rd	4th
Min	3 312	3 667	4 040	3 049
Max	10 915	10 905	11 225	11 102
Numbers	20	20	20	20
Steps	380.191	361.892	359.229	402.670

(Monetary units for Min and Max values are in million RMB)

After get those important factors, the next step is to estimate frequency and probability in 20 different intervals for each quarter. The estimation of frequency and probability can be fulfilled in Excel as well. Let's set first quarter of year 2014 as an example. Firstly, we must list out those 20 different intervals based on calculated data from 2 tables above. Secondly, choose output area and use Excel function "*FREQUENCY (data_array, bins_array)*" to get the results of frequency in each interval. The data we must put into "*data_array*" are those 1 000 different jet fuel costs in first quarter; the data we must fit into "*bins_array*" are these 20 different intervals we calculated before. The last step for this calculation is to press " *Shift*", "*Control*" and "*Enter*" to get different frequencies for each interval. The sum of frequency we get must be equal to 1 000 in our case. When measuring probability for same 20 intervals, we very simply use frequency for each quarter to divide by 1 000 to get answers. To make it more intuitive, we create tables and figures for each quarter in 2014 and 2015. Here are,

Table 4.16 Frequency and probability of jet fuel costs (1st quarter in 2014)

Intervals (1st quarter) (in million RMB)	Frequency	Probability (%)
4 243	1	0.10
4 573	1	0.10
4 903	5	0.50
5 232	3	0.30
5 562	20	2.00
5 892	21	2.10
6 222	44	4.40
6 552	66	6.60
6 882	84	8.40
7 211	98	9.80
7 541	120	12.00
7 871	106	10.60
8 201	115	11.50
8 531	90	9.00
8 860	84	8.40
9 190	48	4.80
9 520	38	3.80
9 850	29	2.90
10 180	15	1.50
10 510	9	0.90
10 840	3	0.30
Sum	1 000	100.00

Table 4.17 Frequency and probability of jet fuel costs (2nd quarter in 2014)

Intervals (in million RMB)	Frequency	Probability (%)
3 595	1	0.10
3 963	3	0.30
4 331	2	0.20
4 700	2	0.20
5 068	10	1.00
5 436	19	1.90
5 804	31	3.10
6 172	70	7.00
6 541	68	6.80
6 909	113	11.30
7 277	121	12.10
7 645	111	11.10
8 013	123	12.30
8 382	103	10.30
8 750	74	7.40
9 118	62	6.20
9 486	44	4.40
9 854	18	1.80
10 223	18	1.80
10 591	6	0.60
10 960	1	0.10
Sum	1 000	100.00

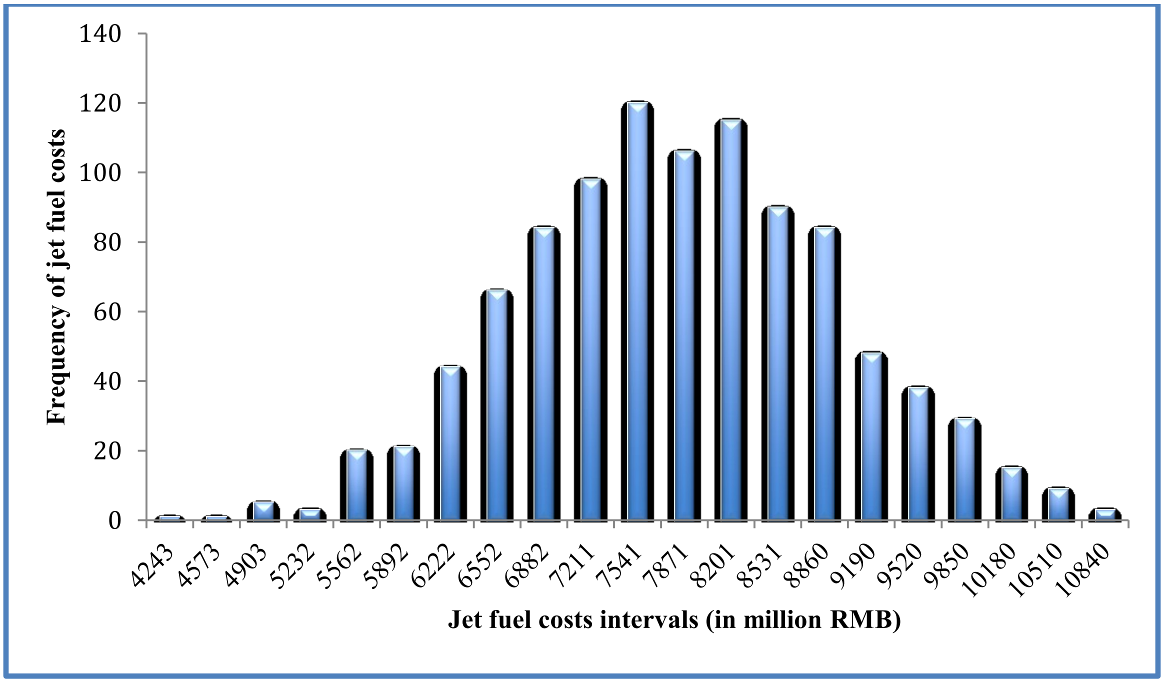
Table 4.18 Frequency and probability of jet fuel costs (3rd quarter in 2014)

Intervals (in million RMB)	Frequency	Probability (%)
3 795	1	0.10
4 160	4	0.40
4 525	1	0.10
4 890	15	1.50
5 255	20	2.00
5 620	36	3.60
5 985	45	4.50
6 350	69	6.90
6 715	106	10.60
7 080	112	11.20
7 445	120	12.00
7 810	117	11.70
8 175	110	11.00
8 540	88	8.80
8 905	54	5.40
9 270	40	4.00
9 635	30	3.00
10 000	16	1.60
10 365	9	0.90
10 730	4	0.40
11 095	3	0.30
Sum	1 000	100.00

Table 4.19 Frequency and probability of jet fuel costs (4th quarter in 2014)

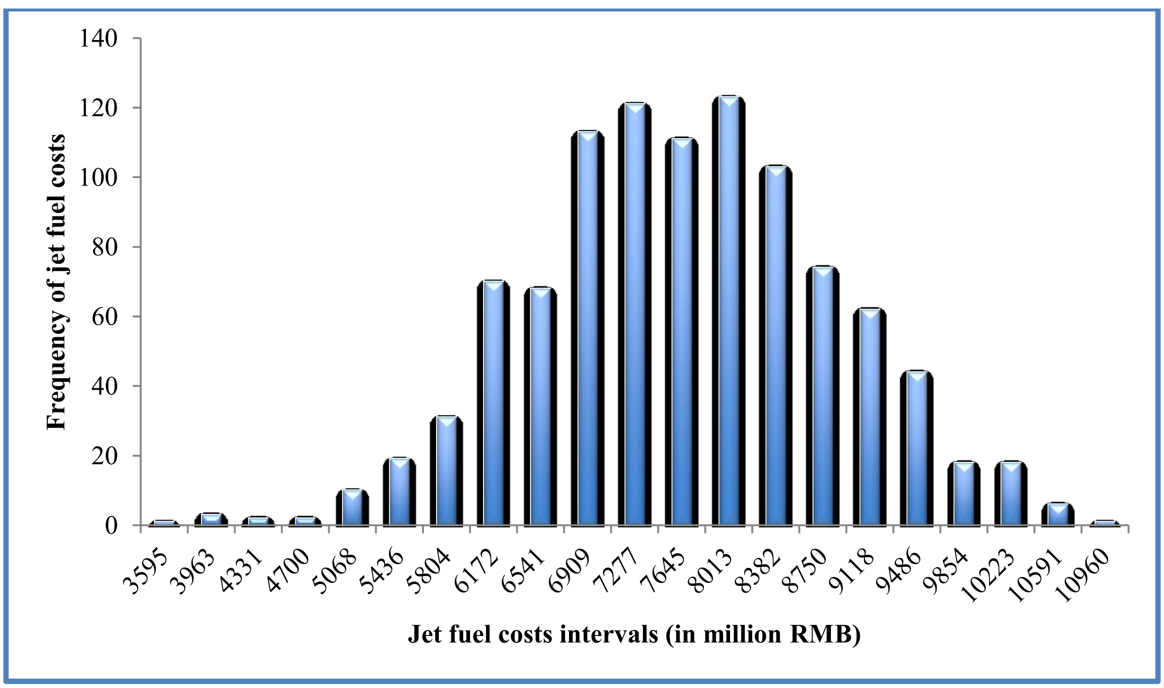
Intervals (in million RMB)	Frequency	Probability (%)
3 178	1	0.10
3 598	2	0.20
4 018	1	0.10
4 438	4	0.40
4 857	16	1.60
5 277	25	2.50
5 697	43	4.30
6 117	62	6.20
6 537	88	8.80
6 957	132	13.20
7 377	136	13.60
7 796	171	17.10
8 216	108	10.80
8 636	77	7.70
9 056	74	7.40
9 476	32	3.20
9 896	14	1.40
10 316	7	0.70
10 736	4	0.40
11 155	1	0.10
11 576	2	0.20
Sum	1 000	100.00

Figure 4.7 Frequency of jet fuel costs (1st quarter in 2014)



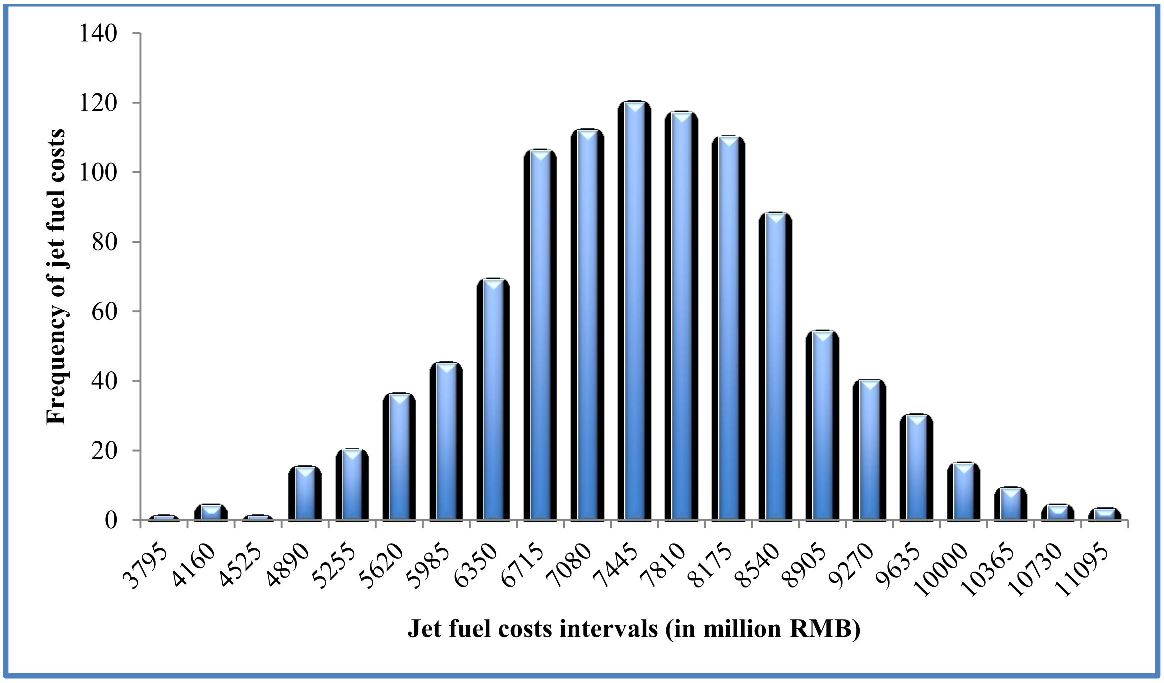
Clearly, we can find that the most frequent jet fuel cost from our 1 000 different predictions is 7 541 million RMB.

Figure 4.8 Frequency of jet fuel costs (2nd quarter in 2014)



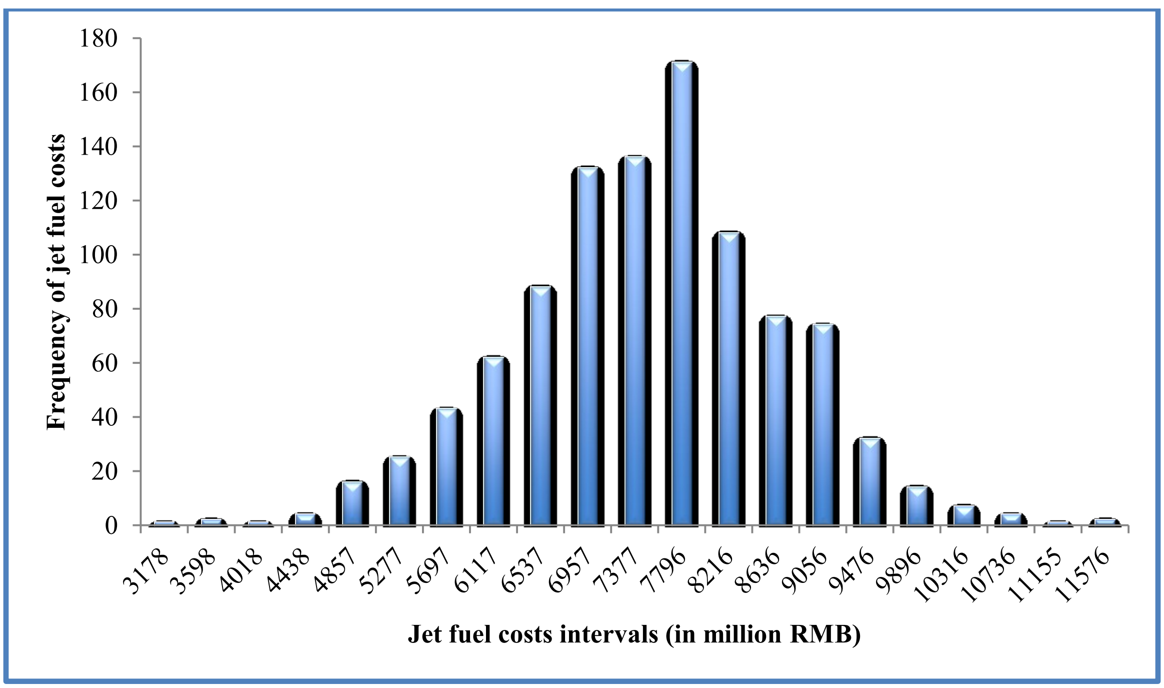
From this Figure above, we can see 8 013 million RMB is the most frequent jet fuel cost in 2nd quarter.

Figure 4.9 Frequency of jet fuel costs (3rd quarter in 2014)



The most frequent jet fuel cost in Figure 4.9 is 7 445 million RMB.

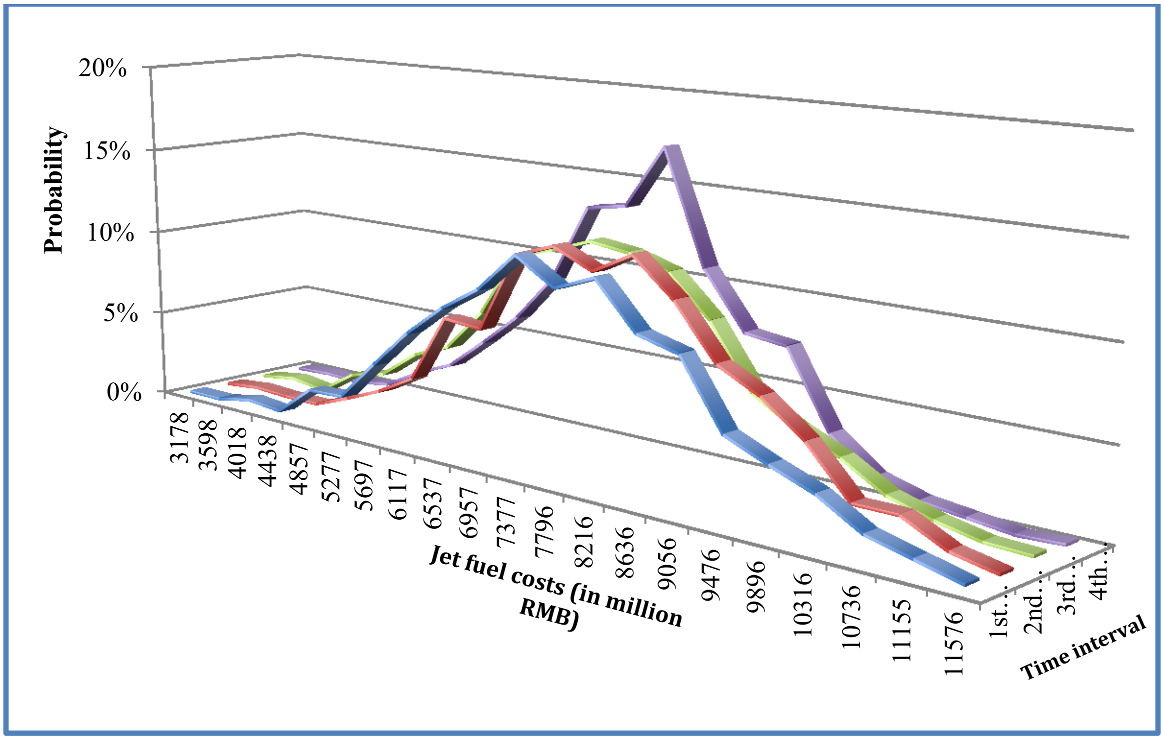
Figure 4.10 Frequency of jet fuel costs (4th quarter in 2014)



From Figure 4.10, the most frequent jet fuel cost is 7 796 million RMB.

When gathering 4 quarters' data together, it can be shown in Figure 4.11.

Figure 4.11 Probability distribution of jet fuel costs in 2014



From Figure 4.11 above, we can conclude that no matter which quarter we measure, the high probability of jet fuel costs are all between 6 957 million RMB and 9 056 million RMB. Generally, the trends can be divided into 2 main parts; one is "increasing" part and another one is "decreasing" part. The jet fuel cost that is closed to 8 636 million RMB is like a "watershed", 4 probability lines all keep increasing before it and afterwards the lines start going down. By using the same way, we can get information in year 2015.

Table 4.20 Frequency and probability of jet fuel costs (1st quarter in 2015)

Intervals (in million RMB)	Frequency	Probability (%)
3 312	1	0.10
3 692	0	0.00
4 072	0	0.00
4 452	5	0.50
4 832	7	0.70
5 213	18	1.80
5 593	40	4.00
5 973	58	5.80
6 353	92	9.20
6 733	111	11.10
7 113	137	13.70
7 494	122	12.20
7 874	116	11.60
8 254	103	10.30
8 634	83	8.30
9 014	51	5.10
9 395	30	3.00
9 775	17	1.70
10 155	4	0.40
10 535	4	0.40
10 916	1	0.10
Sum	1 000	100.00

Table 4.21 Frequency and probability of 2nd quarter in 2015

Intervals (in million RMB)	Frequency	Probability (%)
3 667	1	0.10
4 029	2	0.20
4 391	5	0.50
4 753	10	1.00
5 115	14	1.40
5 476	32	3.20
5 838	50	5.00
6 200	85	8.50
6 562	76	7.60
6 924	128	12.80
7 286	130	13.00
7 648	115	11.50
8 010	111	11.10
8 372	73	7.30
8 733	73	7.30
9 095	39	3.90
9 457	27	2.70
9 819	16	1.60
10 181	7	0.70
10 543	4	0.40
10 905	2	0.20
Sum	1 000	100.00

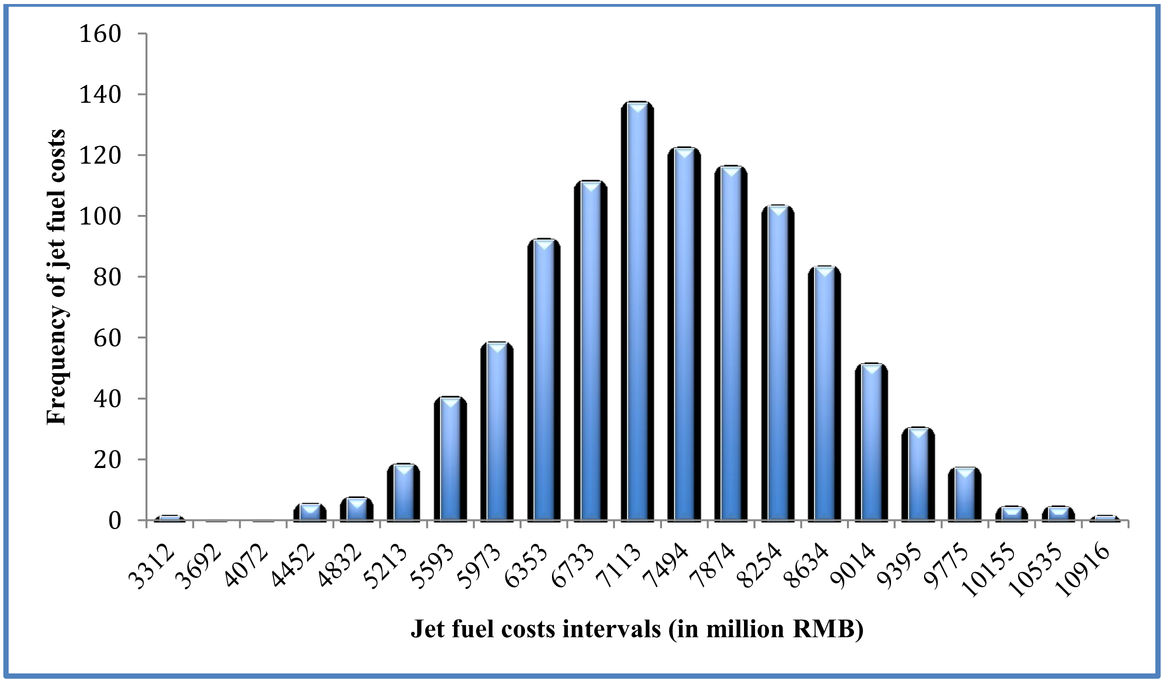
Table 4.22 Frequency and probability of jet fuel costs (3rd quarter in 2015)

Intervals (in million RMB)	Frequency	Probability (%)
4 040	1	0.10
4 399	2	0.20
4 759	13	1.30
5 118	16	1.60
5 477	27	2.70
5 836	50	5.00
6 196	89	8.90
6 555	100	10.00
6 914	96	9.60
7 273	126	12.60
7 632	128	12.80
7 992	118	11.80
8 351	84	8.40
8 710	59	5.90
9 069	28	2.80
9 429	30	3.00
9 788	22	2.20
10 147	5	0.50
10 506	2	0.20
10 866	2	0.20
11 226	2	0.20
Sum	1 000	100.00

Table 4.23 Frequency and probability of jet fuel costs (4th quarter in 2015)

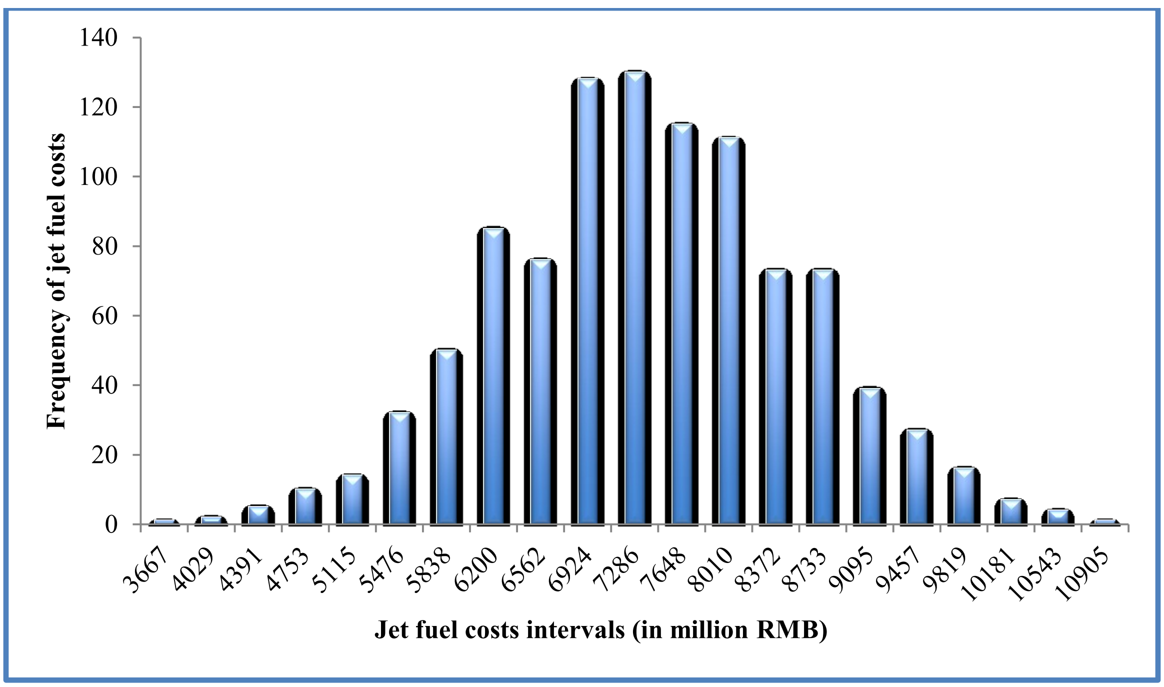
Intervals (in million RMB)	Frequency	Probability (%)
3 049	1	0.10
3 451	0	0.00
3 854	0	0.00
4 257	2	0.20
4 659	9	0.90
5 062	18	1.80
5 465	33	3.30
5 867	83	8.30
6 270	109	10.90
6 673	118	11.80
7 075	143	14.30
7 478	145	14.50
7 881	112	11.20
8 283	92	9.20
8 686	67	6.70
9 089	33	3.30
9 491	20	2.00
9 894	9	0.90
10 297	2	0.20
10 699	0	0.00
11 103	4	0.40
Sum	1000	100.00

Figure 4.12 Frequency of jet fuel costs (1st quarter in 2015)



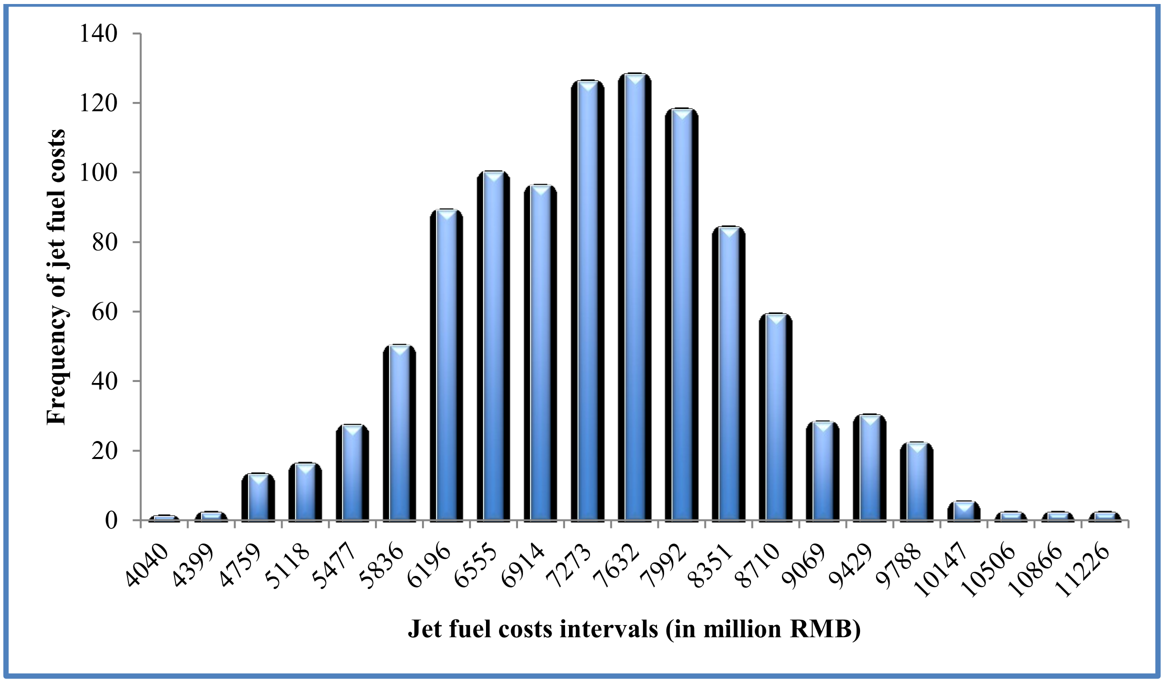
The most frequent jet fuel cost in 1st quarter of 2015 is 7 113 million RMB.

Figure 4.13 Frequency of jet fuel costs (2nd quarter in 2015)



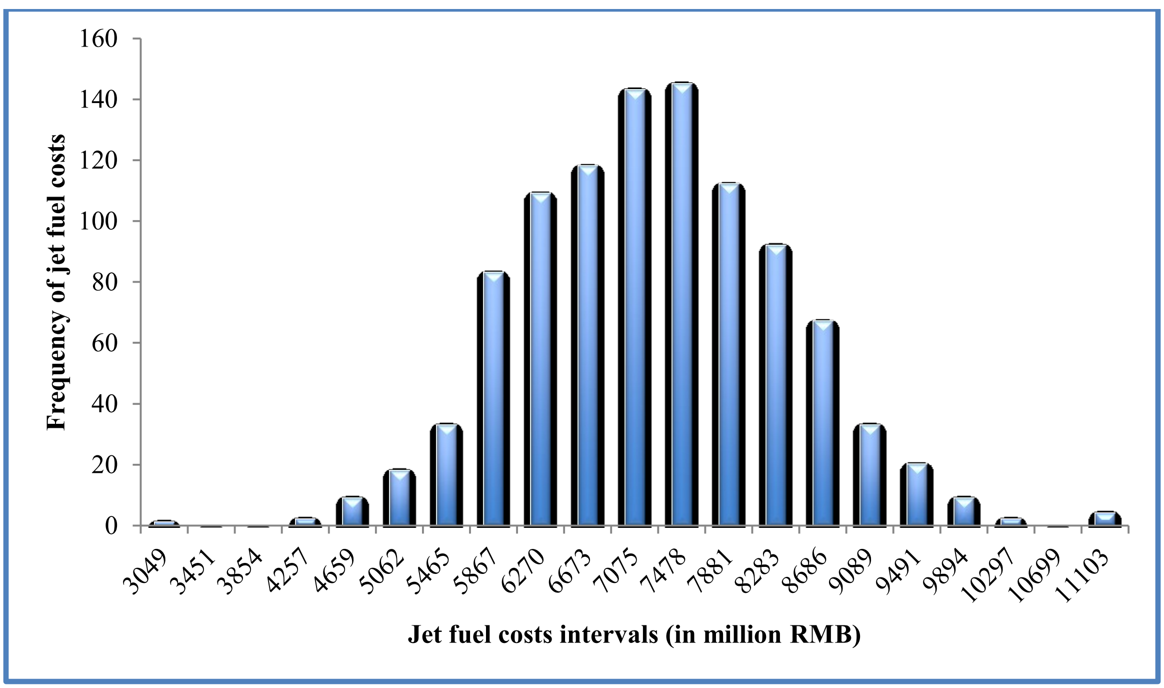
Here we can see that the most frequent jet fuel cost in 2nd quarter of 2015 is 7 286 million RMB.

Figure 4.14 Frequency of jet fuel costs (3rd quarter in 2015)



From Figure 4.14, there is wide range of costs with a very high frequency. It starts from 6 196 million RMB to 8 351 million RMB. But the most frequent one is 7 632 million RMB.

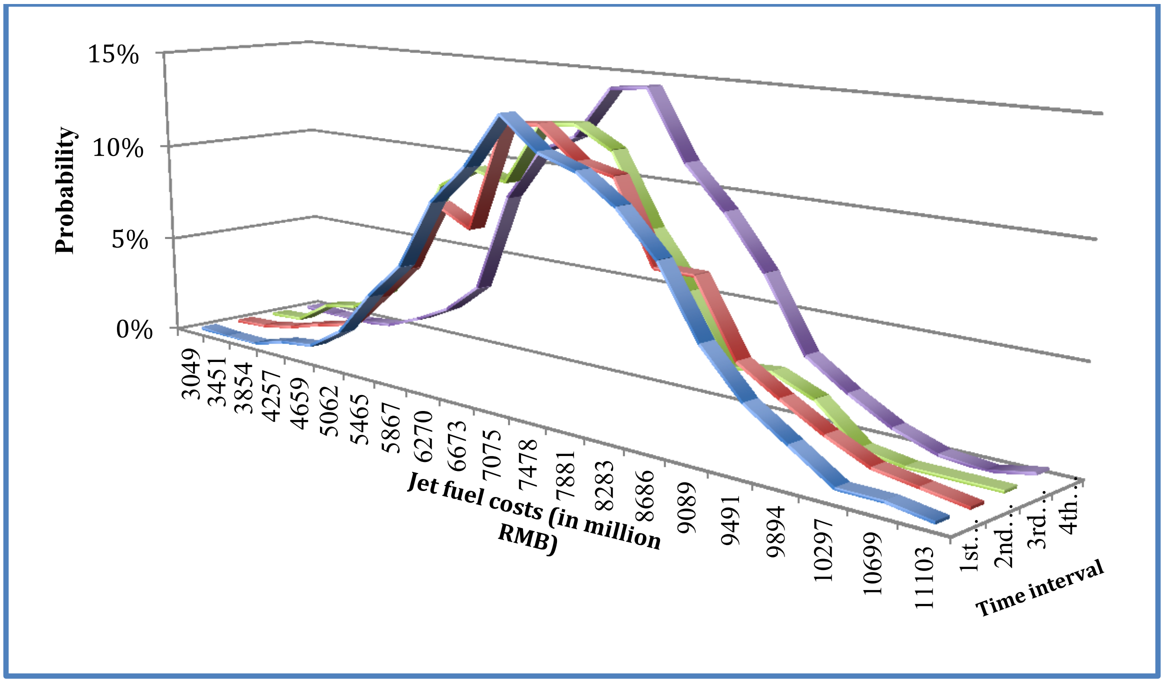
Figure 4.15 Frequency of jet fuel costs (4th quarter in 2015)



From Figure 4.15, the most frequent jet fuel cost is between 5 867 and 8 686 million RMB.

If we want to figure out the probability distribution of jet fuel costs in 2015, the results can be drawn in Figure 4.16.

Figure 4.16 Probability distribution of jet fuel costs in 2015



From Figure 4.16, we can easily see that the most probabilities of jet fuel costs in each quarter are between 6 270 million RMB and 8 686 million RMB.

4.3.3 Yearly Prediction of Profit

From all previous parts in this chapter, we've already calculated all revenues in 2014 and 2015. And also, all costs in each quarter of 2014 and 2015 are predicted. Due to 1 000 different jet fuel costs, we can use total revenues minus 1 000 different total costs separately in 2014 and 2015 to get 1 000 different earnings before tax. In order to make graph clearer, we will only use yearly data we predict in 2014 and 2015 as our example. The equation we can use is,

$$EAT_t^i = \left[REV_t - JFC_t^i \cdot Q \cdot K_t^i - VC_t - FC_t\right] \cdot (1 - T). \quad (4.7)$$

where EAT_t^i is the earning after tax at time t, VC_t and FC_t represent variable costs and fixed costs at time t respectively.

4.3.3.1 Probability Analysis of EAT

From past few year annual reports, we find that the tax every year in this industry in China was about 20%. And, this rate did not change a lot. Hence, we assume that the tax rate in 2014 and 2015 will be fixed and expressed as 20%. In this case, we can use formula (4.6) to get 1 000 different earnings after tax in year 2014 and 1 000 different earnings after tax in year 2015. By using the same function in Excel, we can get the minimum number, maximum number, and steps for each year. See Table 4.24.

Table 4.24 Frequency analysis factors of EAT in 2014 and 2015

Items/Yearly	2014	2015
Min	251	2,278
Max	13 857	16 647
Numbers	20	20
Steps	680.331	718.471

(Monetary units for Min and Max values are in million RMB)

Afterwards, we can get Table 4.25.

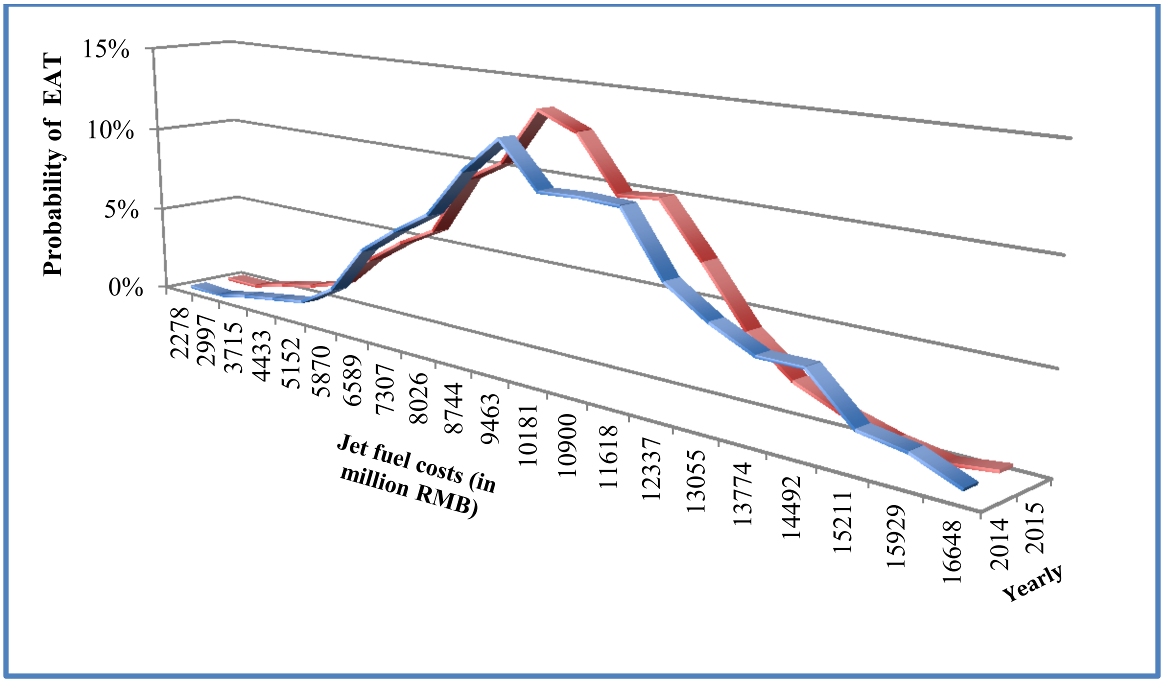
Table 4.25 Frequency and probability of EAT in 2014 and 2015

EAT					
2014			2015		
Intervals	Frequency	Probability (%)	Intervals	Frequency	Probability (%)
251	1	0.10	2 278	1	0.10%
931	0	0.00	2 997	1	0.10%
1 611	4	0.40	3 715	6	0.60%
2 292	7	0.70	4 433	10	1.00%
2 972	10	1.00	5 152	16	1.60%
3 652	22	2.20	5 870	35	3.50%
4 333	49	4.90	6 589	49	4.90%
5 013	64	6.40	7 307	60	6.00%
5 693	77	7.70	8 026	93	9.30%
6 374	104	10.40	8 744	105	10.50%
7 054	124	12.40	9 463	136	13.60%
7 735	100	10.00	10 181	127	12.70%
8 415	101	10.10	10 900	98	9.80%
9 095	100	10.00	11 618	100	10.00%
9 775	67	6.70	12 337	72	7.20%
10 456	52	5.20	13 055	42	4.20%
11 136	41	4.10	13 774	23	2.30%
11 816	41	4.10	14 492	13	1.30%
12 497	18	1.80	15 211	6	0.60%
13 177	14	1.40	15 929	2	0.20%
13 858	4	0.40	16 648	5	0.50%

(Monetary units for intervals are in million RMB)

Putting the probability data from each year into the same graph, we can easily recognize the similarities and differences between 2014 and 2015.

Figure 4.17 Probability distribution of EAT in 2014 and 2015



In Figure 4.17, the high probability of earning after tax the company can get in this case is between 8 026 million RMB and 11618 million RMB. Separately, the highest probability of earning after tax we assume is 7 054 million RMB in 2014 and 9 463 million RMB. Besides, the trends of these two years are almost the same, but the earning after tax in 2015 is generally a little bit higher than results in 2014.

4.3.3.2 Sensitivity Analysis of "EaR" and "ES"

In this sub-part, we will use two ways to show the sensitivity of earning after tax at different risks in 2014 and 2015. One is "EaR", which is earning at risk, in our case, we assume different probable risks (1%, 3%, 5%, 7% and 10%), and the "EaR" is a spot number at each risk we set. However, another "ES" is an average number before each risk. Before drawing sensitivity graphs, we must estimate the mean, standard deviation and median number of earnings after tax in each year. Here is,

Table 4.26 Sensitivity analysis factors in 2014 and 2015 (in million RMB)

	Mean	Standard deviation	Median
2014	7 450	2 365.4	7 341
2015	9 378	2 299.9	9 408

If we assume risks are in 1%, 3%, 5%, 7% and 10% in each year. We can create Table 4.27 and Table 4.28.

Table 4.27 "EaR" in 2014 and 2015 (in million RMB)

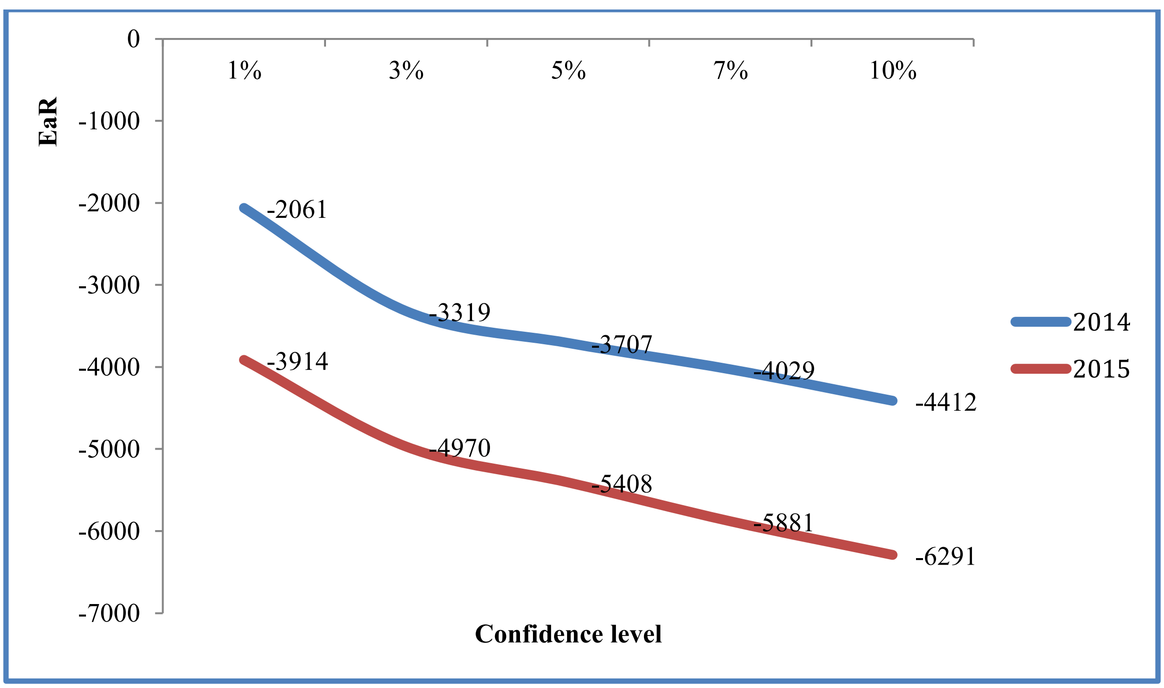
	EaR				
Confidence level	1%	3%	5%	7%	10%
2014	-2 061	-3 319	-3 707	-4 029	-4 412
2015	-3 914	-4 970	-5 408	-5 881	-6 291

Table 4.28 "ES" in 2014 and 2015 (in million RMB)

	ES				
Confidence level	1%	3%	5%	7%	10%
2014	-1 516	-2 369	-2 845	-3 141	-3 468
2015	-3 320	-4 108	-4 565	-4 883	-5 252

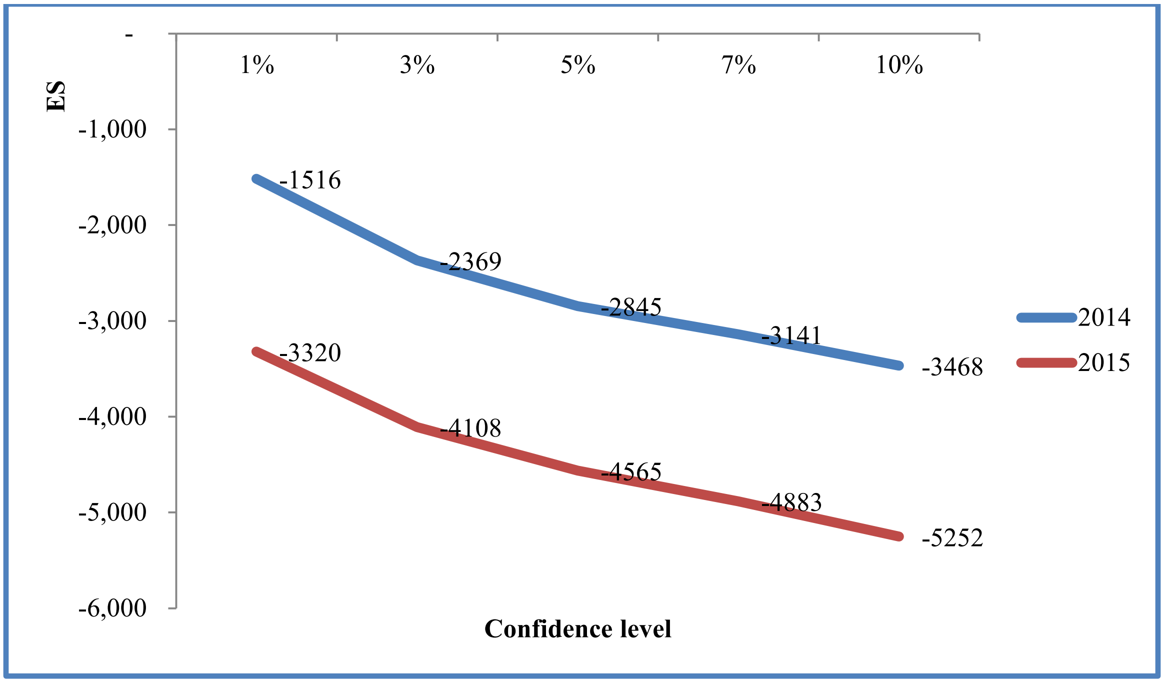
Considering the data we estimated above, we can draw 2 graphs for each year.

Figure 4.18 Sensitivity analysis of "EaR" in 2014 and 2015



From Figure 4.18, the blue curve is earning after tax in year 2014 and the red one is the earning after tax in year 2015. Here we can see that the earning after tax keeps decreasing from lower significant level to higher significant level not only in 2014 but also in 2015. The distance between these 2 years in this figure are almost the same at different confidence levels.

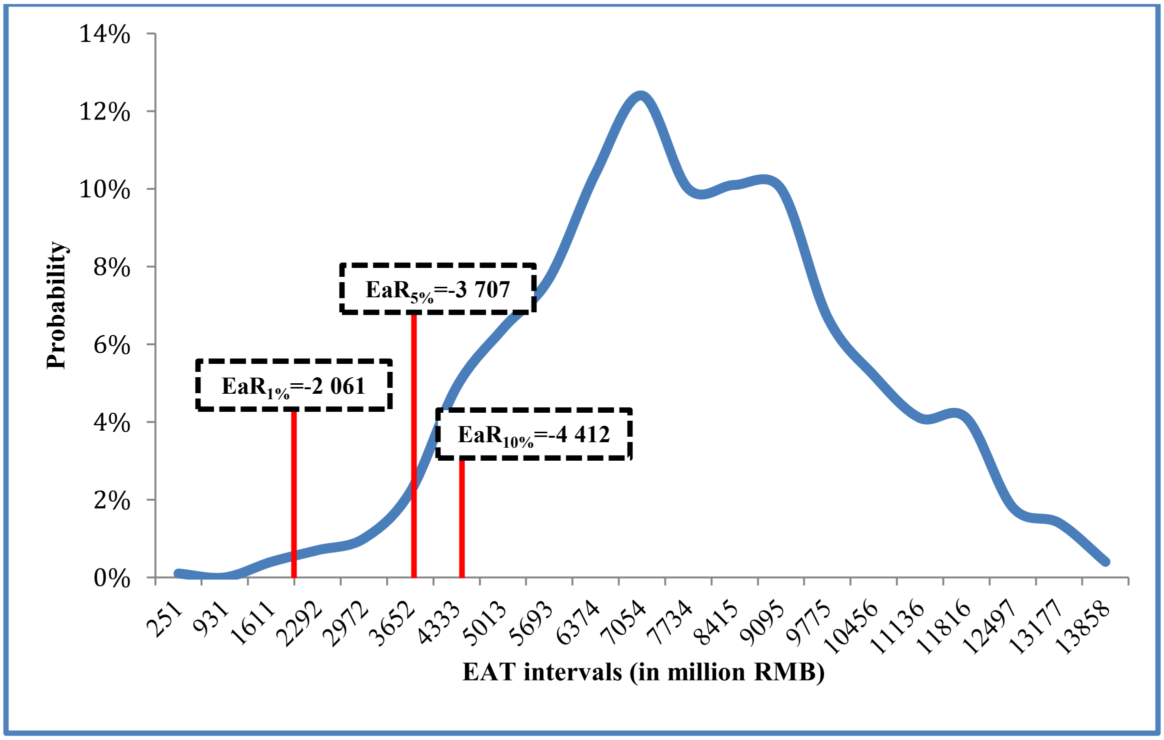
Figure 4.19 Sensitivity analysis of “ES”



From Figure 4.19, we can realize that even we have the different ways to calculate the company’s earning at risk. The 2 curves’ trend in 2014 and 2015 are very similar to curves’ trend in Figure 4.18.

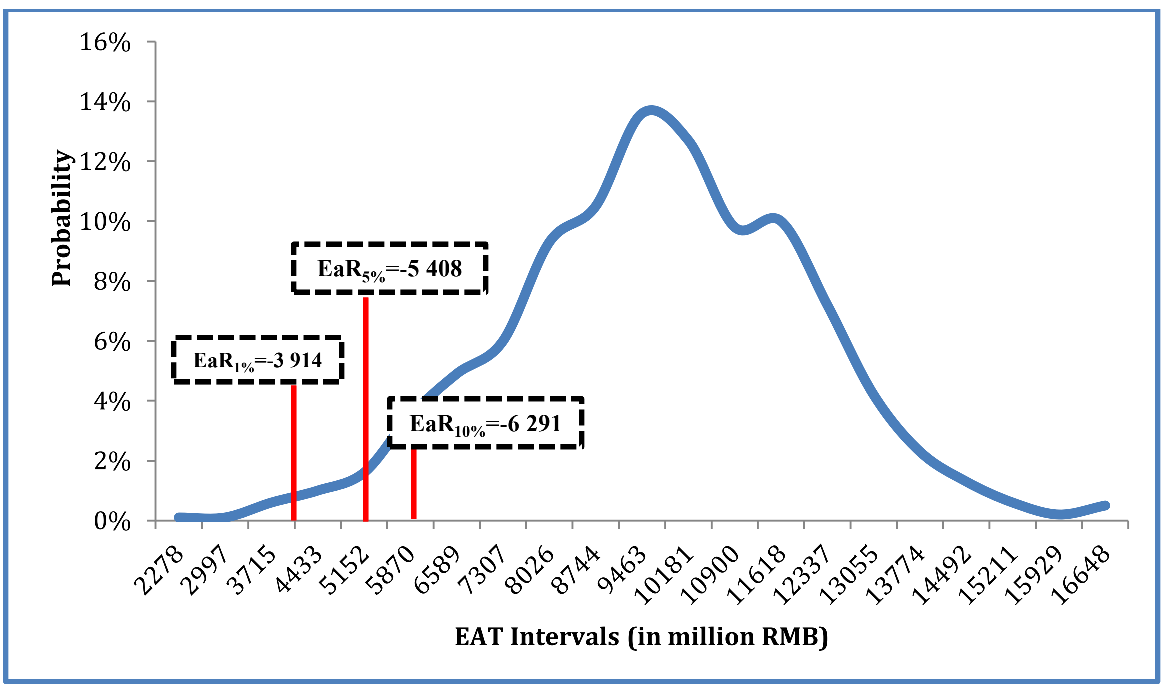
Then, if we combine the earnings at different risks with probability of earnings after tax, we can get Figure 4.20 and Figure 4.21.

Figure 4.20 Distribution of earning after tax in 2014



Setting $EaR_{1\%}$ as an example, we can say that with 1% probability that the earning after tax will be lower than 2 061; oppositely, the earning after tax will be higher than 2 061 with the 99% probability.

Figure 4.21 Earning after tax in 2015

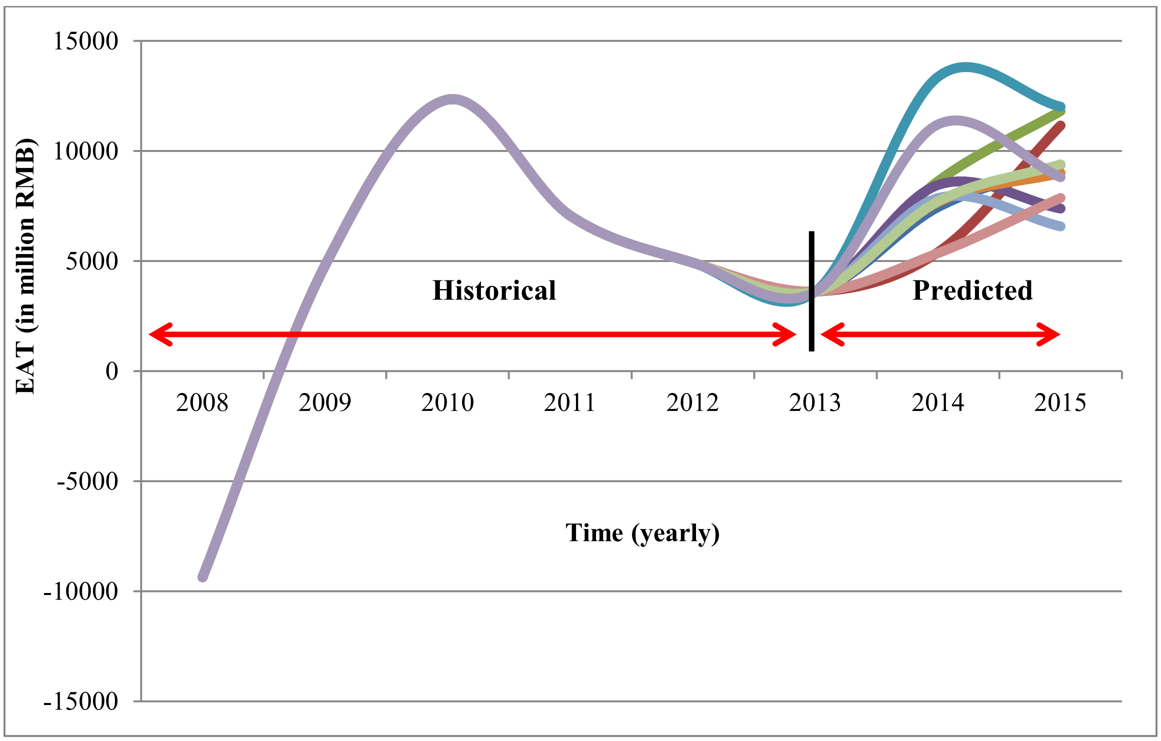


From figure above, we can say that we have 1% probability confidence that jet fuel costs in 2015 will be lower than 3 914 million RMB.

4.3.4 Periodical EAT of Air China

Considering each part of Chapter 4, we've already summarized total revenues and costs from 2008 to 2013. For the predictions about next 2 year, here we can draw a figure the show the general trend of net profit from 2008 to 2015.

Figure 4.22 Summary of the EAT from 2008 to 2015



The first year in Figure 4.22, we can see the curve is under 0, which means the company Air China did not make any profit in 2008. The most important reason for this reality is financial crisis had very bad influence the whole word economy. From 2008 to 2010, we can see there is a big increasing during that period, which means Air China made lots of profits during that period, one reason is the support from China government and another reason is due to Air China's correct decision-making and long management history. Unluckily, from 2010 to 2013, even Air China still makes profits, but relatively lower and lower. For the future, in our paper, the year 2013 is a turning point; the profits Air China will make starts to go up after 2013.

5. Conclusion

Air China Company is one of the biggest airline companies in China, which plays an important role in the whole economy. The main objective of this thesis is to apply CorporateMetrics methodology for predicting the earnings after tax of Air China Company in year 2014 and 2015 and estimating Earnings at different level of risks.

First, we choose 2 financial variables as our input data, which are jet fuel costs and RMB/USD exchange rate. Then, we create 1000 random scenarios as our observation sample. From Geometric Brownian motion, we find out the trend of RMB/USD exchange rate keeps decreasing in every month of 2014 and 2015. By using Vašíček model, the jet fuel cost has a stable price 2.621 USD in a long run; no matter how many scenarios we create, they always surround this equilibrium line.

Based on the historical income statements from 2008 to 2013, we can also easily get 1000 different earnings before tax in 2014 and 2015. The taxation in China aviation industry is 20% and it does not change a lot. Then we suppose that the tax is a fixed factor with 20% in our paper. Finally, the average of the earning after tax in 2014 is 7 450 million RMB and in 2015 is 9 378 million RMB. The trend keeps increasing, which means Air China Company will make more net profits in the future.

Considering the quantification of risk methodology, we find that with 1% probability that the earning after tax will be lower than 2 061 million RMB in 2014 and we have 1% probability confidence that jet fuel costs in 2015 will be lower than 3 914 million RMB.

The overall results of this study tell that the trend of net profit in 2014 and 2015 is going to increase based on 1000 scenarios. And from those 1000 different values, we can find exactly the earnings after tax at different level of risks in each upcoming year. All in all, after financial crisis in 2008, Air China Company starts to make profits again and from our thesis, we do believe Air China Company will continue making profits and playing a more important role in airline industry all over the world.

Bibliography

[1] GEORGE CAMPBELL. *Measures and Metrics in Corporate Security*. 2^{nd} ed. New York: Elsevier, 2014. 176p. ISBN 978-0128006887.

[2] SIMON BENNINGA. *Financial Modeling*. 4^{th} ed. New York: The MIT Press, 2014. 1144 p. ISBN 978-0262027281.

[3] WAYNE WINSTON. *Microsoft Excel 2013 Data Analysis and Business Modeling*. 1^{st} ed. New York: Microsoft Press, 2014. 888 p. ISBN 978-0735669130.

[4] CHRISTIAN SZYLAR. *Handbook of Market Risk*. 1^{st} ed. New York: Wiley, 2013. 432 p. ISBN 978-1118127186.

[5] HULL. *Risk Management and Financial Institutions*. 3^{rd} ed. New York: Wiley, 2012. 672p. ISBN 978-1118269039.

Electronic Bibliography

[6] RISKMETRICS GROUP. CorporateMetrics Technical Document [online]. [20.4.2015]. Riskmetric group [1999]. Available on https://www.riskmetrics.com

[7] Wikipedia [online]. [20.4.2015]. Available on http://en.wikipedia.org/wiki/Air_China

[8] The annual report of Air China Company (2008-2013) [online]. [20.4.2015]. Available on http://www.airchina.com.cn/www/en/html/index/ir/relations/

[9] Jet fuel price monthly data from index mundi [online]. [20.4.2015]. Available on http://www.indexmundi.com/commodities/?commodities=jet-fuel&months=360&currency=cny

[10] Yuan Renminbi to US dollar exchange rate from index mundi [online]. [20.4.2015]. Available on http://www.indexmundi.com/xrates/graph.aspx?c1=CNY&c2=USD&days=3650

List of Abbreviations

VaR	Value at risk
EaR	Earning at risk
ES	Expected shortfall
PLF	Passenger load factor
RMB	Yuan Renminbi
USD	United States Dollars
EAT	Earning after tax

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Ostrava dated 20th April, 2015

Bo Peng

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List of Annexes

Annex 1

Income statement (RMB' million)

Items/Periods	2008	2009	2010	2011	2012	2013
Air traffic revenue	50537	48092	78209	93343	95319	94603
Other operating revenue	2371	3302	4278	5066	5518	3578
Finance revenue	1584	140	1980	3361	375	2265
Jet fuel costs	22614	14466	24096	34703	35638	33722
Take-off, landing and depot charges	5538	5789	7707	8741	9185	9585
Depreciation	6365	7051	8569	9561	10376	10937
Aircraft maintenance, repair and overhaul costs	1804	1768	2577	2613	3259	3064
Employee compensation costs	5844	6627	9852	12270	13648	14024
Air catering charges	1444	1519	2044	2663	2843	2572
Aircraft and engine operating lease expenses	2400	2319	3488	3932	3486	4006
Other operating lease expenses	448	478	712	669	740	915
Other flight operation expenses	4666	4532	8228	9343	6886	8257
Selling and marketing expenses	2603	3085	4603	5481	5668	5760
General and administrative expenses	1089	1016	1638	2262	898	1221
Finance costs	2049	1198	1449	1594	2411	2688